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THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

THE BULLETIN

OF THE

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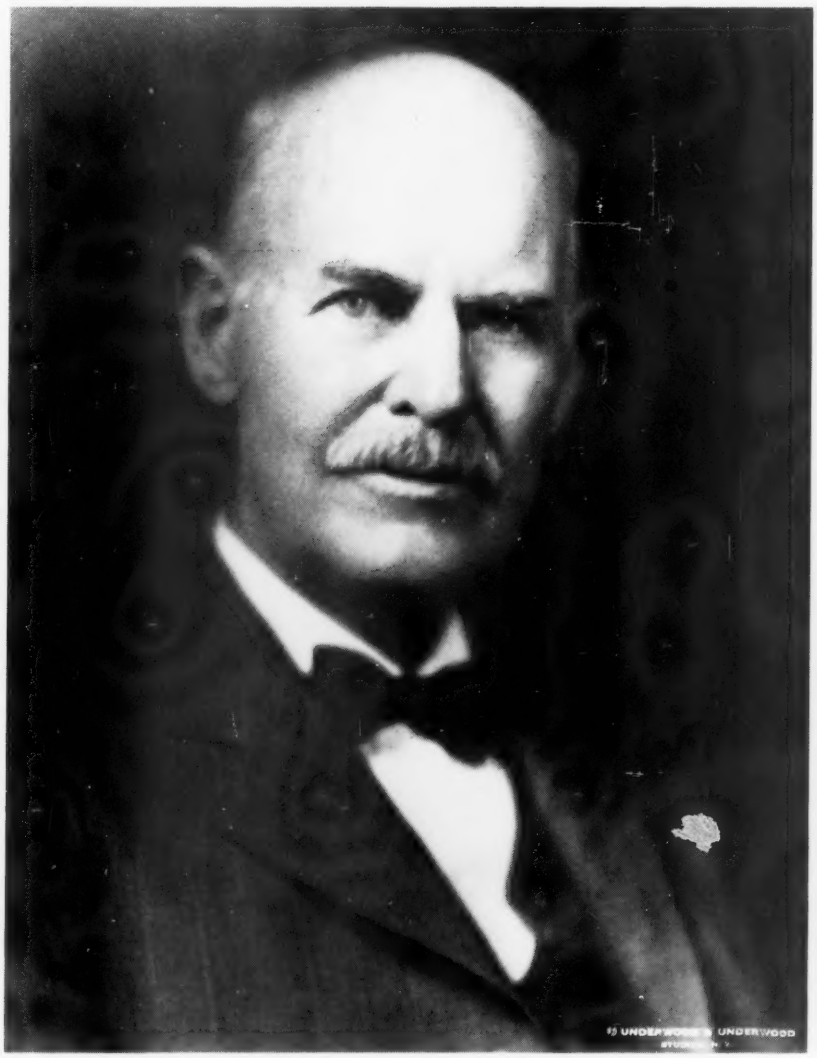
Volume 20 OCTOBER, 1941 Number 10



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For story, see page 342

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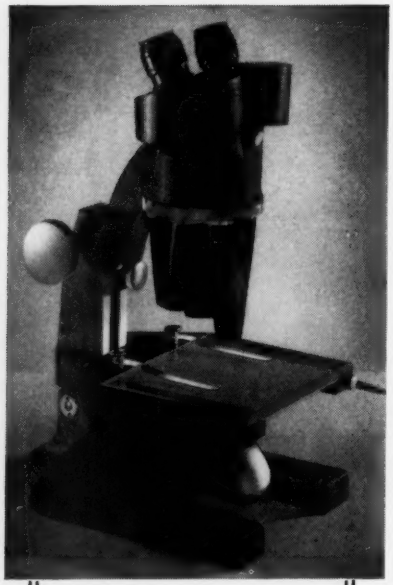

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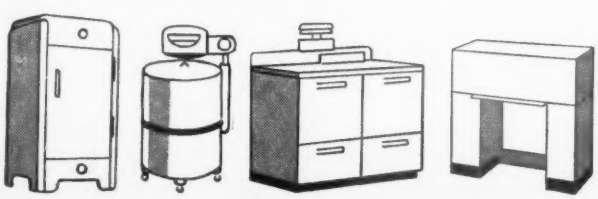

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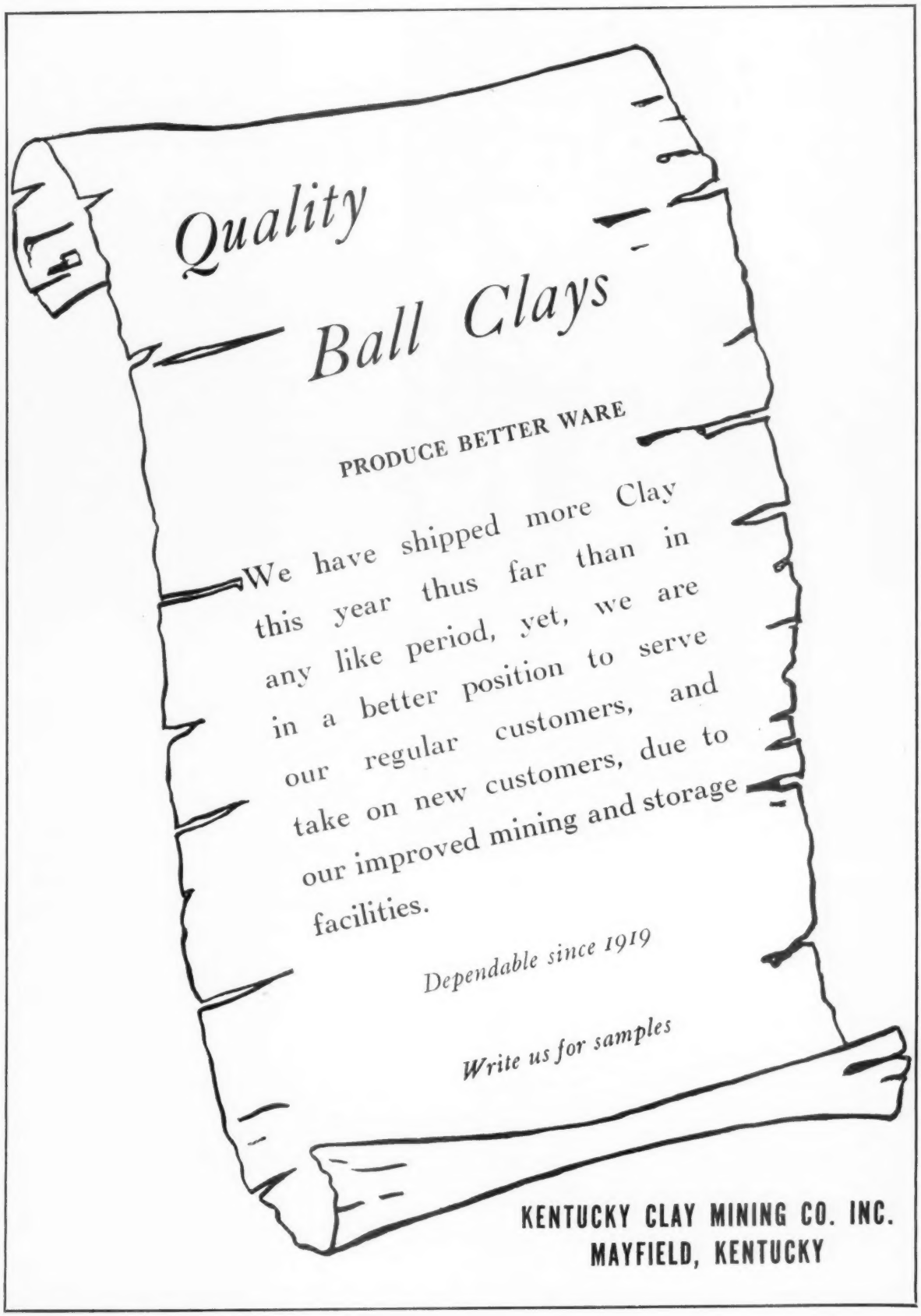
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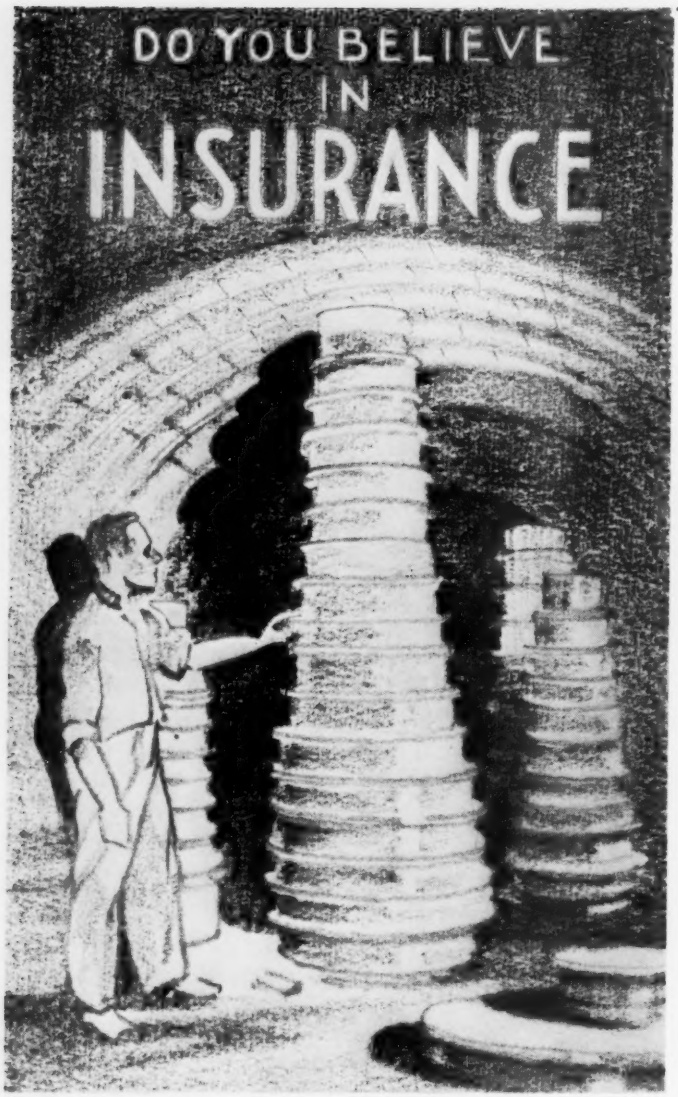

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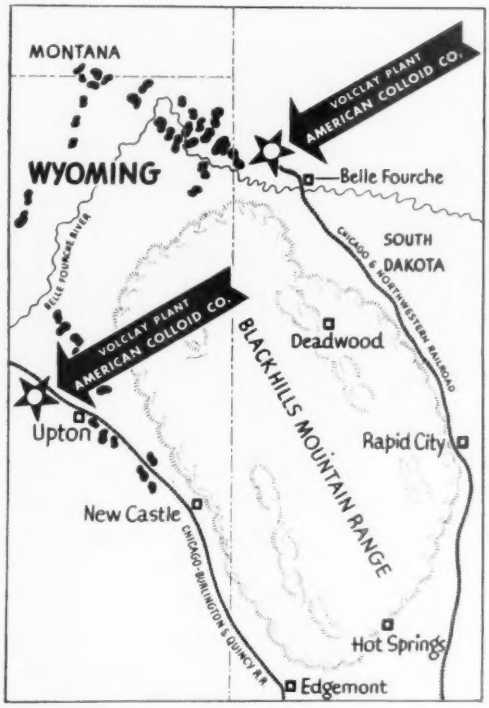

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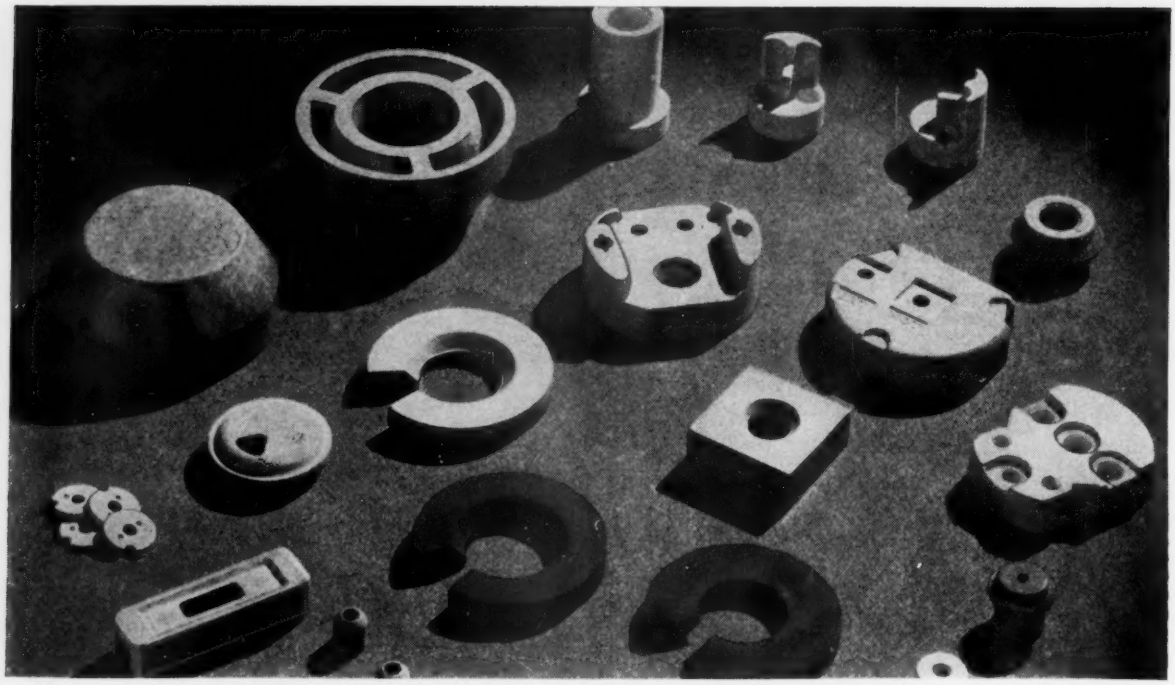

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Volume 20 **OCTOBER, 1941** **Number 10**

PAPERS

WHITE FIRING TEXAS VOLCANIC ASH AS A BODY INGREDIENT*

By Forrest K. Pence

Abstract

The advantages of volcanic ash for use in the ceramic industry are discussed. Two ashes are described in detail and data concerning them and their effects on a clay body are given.

I. Introduction

The low cost of volcanic ash and its wide distribution in certain areas have aroused interest in its possible ceramic uses. The iron content, however, has restricted the range of these proposed uses.[1] The ashes that occur in some parts of the Texas coastal plain of Tertiary age have been altered in part or wholly to various forms of bentonite. In the process of weathering, the normal iron content sometimes appears to have been leached out and either removed entirely or deposited in more concentrated layers that may be removed by mechanical processing. This has resulted in white-firing strata, which are composed chiefly of montmorillonite and which have a combination of physical properties that render the clay useful for extensive ceramic uses.

II. Types of Weathered Ash Used

The material from two distinctive deposits of altered volcanic ash was used as the basis of a porcelain body composition. One of these deposits is a white and open-firing stratum from Gonzales County; the other deposit, which is located near Falls City in Karnes County, fires to a cream-white and vitrifies at cone 1.

Table I gives the chemical analysis† of these ash deposits.

The Gonzales and Falls City materials, which are quite plastic, were combined to replace the typical porcelain body ingredients for a plastic body composition.

The thermal-analysis curves of these materials indicate an alteration from the original ash in the direction of montmorillonite.

Table I

	Gonzales ash (%)	Falls City ash (%)
Ignition loss	9.16	12.70
Silica	71.00	66.64
Alumina	13.00	14.05
Ferric oxide	0.85	1.19
Calcium oxide	1.20	0.46
Magnesium oxide	2.04	2.26
Sodium oxide	2.30	2.56
Potassium oxide	0.60	0.60
Total	100.14	100.46

A standard hotel china body[2] was used, and Fig. 1 (A) shows the extremes of a triaxial that was made up. Table II shows the composition of the three bodies.

Table II

Body Composition

Body No.	Material used	Weight (%)	
No. 1 (Gonzales)	Gonzales ash		27.5
	Flint		36.5
	N. C. kaolin		36.0
No. 6 (Falls City)	Falls City ash		27.5
	Flint		36.5
	N. C. kaolin		36.0
No. 21 (standard)	Tenn. ball clay No. 5	9.0	27.5
	Dolomite	1.5	
	Tenn. feldspar	17.0	
	Flint		36.5
	N. C. kaolin		36.0

Blends of these bodies were made by blunging, sieving, filter pressing, and extruding with the deairing treatment. Bisque firing was carried to cone 11. The composition of twenty-five bodies and data concerning them are given in Table III.

The body composition, water of plasticity, and dry-

* Presented at the Forty-Third Annual Meeting, The American Ceramic Society, Baltimore, Md., April 3, 1941 (White Wares Division). Received June 23, 1941.

[1] Norman Plummer, "Ceramic Uses of Volcanic Ash," *Bull. Amer. Ceram. Soc.*, **18** [1] 8–11 (1939).

† Analysis made by J. E. Stullken, chemist, Bureau of Industrial Chemistry, University of Texas, Austin, Texas.

[2] H. Thiemecke, "Thermal and Moisture Expansion of Kaolins and Bodies Fired to Different Temperatures," *Jour. Amer. Ceram. Soc.*, **24** [2] 69–75 (1941); p. 70.

ing shrinkage are shown in Fig. 1 (A, B, C); firing shrinkage, total shrinkage, modulus of rupture, and absorption are given in Fig. 2.

Because apparent plasticity and modulus of rupture values increase rapidly with an increase in either of the altered ashes, plasticity measurements[3] were made on typical bodies by the use of torsion curves (see Fig. 3).

Figure 4 (A) shows the results of a study of color and glaze fit; a fritted tableware glaze, fired to cone 2, was used on the bisque pieces.

The glazed pieces were submitted to temperature

[3] R. P. Graham and J. D. Sullivan, "Improved Machine Shows Different Forms of Failure of Clay Bodies in Torsion," *Bull. Amer. Ceram. Soc.*, **18** [3] 97–100 (1939).

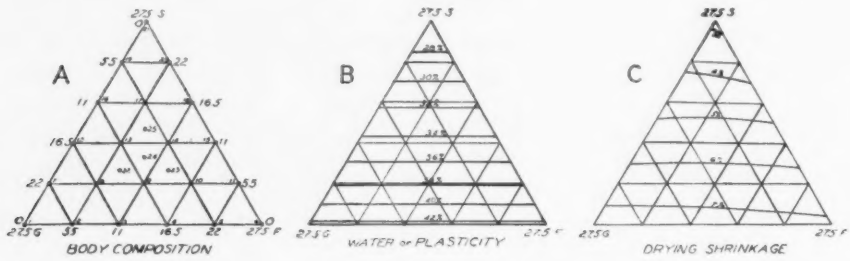

FIG. 1.

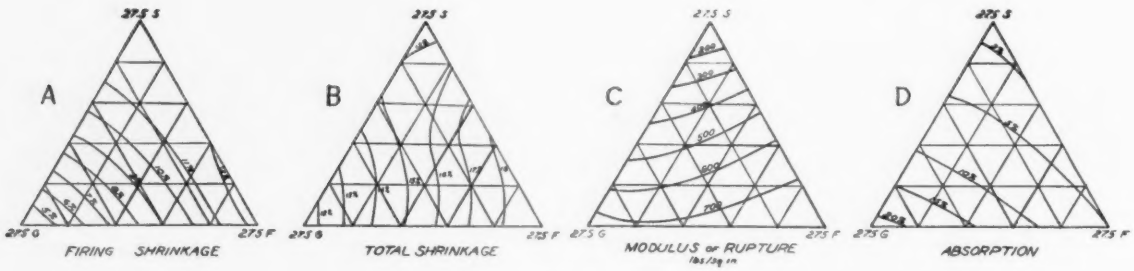

FIG. 2.

TABLE III

BODY COMPOSITIONS AND CORRESPONDING DATA

Column (1), body No.; (2), Gonzales body (%); (3), Falls City body (%); (4), standard body (%); (5), water of plasticity; (6), drying shrinkage; (7), firing shrinkage; (8), total shrinkage; (9), absorption (%); (10), modulus rupture (lb./sq. in.).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	100	0	0	43.1	7.4	3.95	11.35	17.8	782
2	80	20	0	45.5	9.0	4.94	13.94	18.8	685
3	60	40	0	39.1	7.4	6.47	13.87	14.8	718
4	40	60	0	40.8	7.4	8.89	16.29	12.7	662
5	20	80	0	40.7	7.1	10.67	17.77	8.4	792
6	0	100	0	43.3	6.3	12.45	18.75	5.3	767
7	80	0	20	34.4	6.3	6.33	12.63	15.1	550
8	60	20	20	34.7	6.3	7.31	13.61	11.5	573
9	40	40	20	37.8	6.3	9.39	15.69	9.2	748
10	20	60	20	35.3	6.2	10.67	16.87	6.2	893
11	0	80	20	40.0	6.3	12.24	18.54	5.2	693
12	60	0	40	33.2	5.6	7.90	13.50	9.5	452
13	40	20	40	35.5	5.6	10.08	15.68	7.9	758
14	20	40	40	33.2	5.4	10.87	16.27	5.0	640
15	0	60	40	35.6	5.4	12.84	18.24	3.7	646
16	40	0	60	32.0	4.9	10.48	15.38	6.5	365
17	20	20	60	31.2	4.7	11.07	15.77	4.3	485
18	0	40	60	33.0	5.4	11.86	16.26	1.6	422
19	20	0	80	27.7	3.8	11.27	15.07	2.5	224
20	0	20	80	28.2	3.8	12.05	15.85	1.5	176
21	0	0	100	27.6	2.7	11.47	14.17	1.1	85
22	46.7	26.7	26.7	34.3	5.4	8.90	14.30	9.7	560
23	26.7	46.7	26.7	35.7	5.4	10.83	16.23	7.5	575
24	33.3	33.3	33.3	33.6	5.6	10.08	15.68	7.4	560
25	26.7	26.7	46.7	32.0	5.1	12.45	17.55	5.6	516

shock sufficient to craze the glazes on bodies in the No. 21 area (see Fig. 4 (B)).

III. Conclusions

A substantial amount of the Falls City altered ash may be used to replace ball clay and feldspar. Although kaolin is kept constant in the series, its replacement is indicated, particularly by the Gonzales ash.

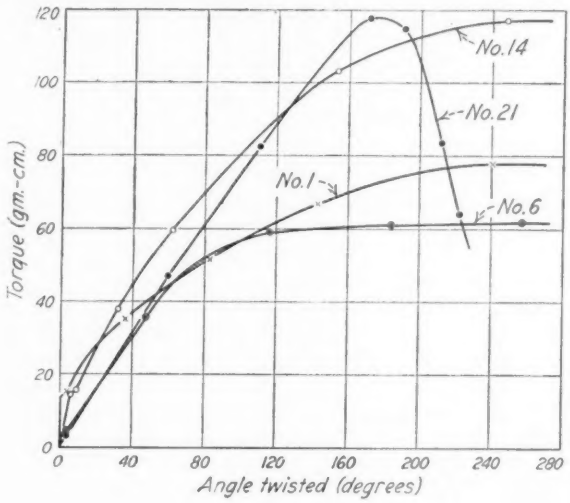

FIG. 3.

The introduction of altered ash has given rise to the following properties: (1) satisfactory strength of plasticity is maintained with a greatly increased elastic range as shown by torsion curves; (2) the strength after drying is phenomenal as shown by the rapid increase in modulus of rupture with increase in ash content; (3) the degree of whiteness is increased, particularly toward the Gonzales body area; and (4) the range of glaze fit is greatly widened (a wide area of ash bodies remained standing after those in the standard body area had failed).

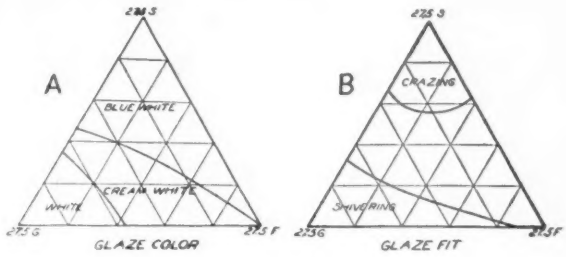

FIG. 4.

Other qualities, such as moderate shrinkage and freedom from warpage, were satisfactory. The working properties will probably be satisfactory for jiggering and general plastic processes. A small percentage of ball clay appears to give increased smoothness and permits somewhat greater variation in the water of plasticity.

The easy availability of these altered ashes is another important factor in their economic value to the porcelain industry.

Acknowledgment

The writer wishes to acknowledge the assistance of W. W. McLean, James Hardgrave, Roy T. McCutchan, and Melvin Nobles in obtaining data presented in this paper.

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DIRECT DETERMINATION OF VANADIUM IN THE PRESENCE OF TITANIUM AND IRON*

BY SANDFORD S. COLE AND CHARLES A. KUMINS

ABSTRACT

A rapid and accurate method for the determination of vanadium in the presence of iron and titanium was obtained by the use of orthophenanthroline indicator to establish vanadium in tetravalent form. Boiling the solution to destroy the indicator and subsequent titration with $KMnO_4$ gave variations of $\pm 1\%$. Improvements in technique for the determination of titanium in the presence of vanadium and iron are discussed, and results are given for the oxidation of the reduced solution with ferric ammonium sulfate and potassium permanganate.

I. Introduction

In the determination of elements that have one or more valence changes, the problem in the analytical procedure is to establish the complete oxidation or reduction from a given state of valency. Methods of determining iron, vanadium, and titanium in a combined state have been investigated to obtain a direct evaluation either of iron or of vanadium, but the titanium has to be obtained with vanadium or in conjunction with iron and vanadium. The accuracy of

* Presented at the Forty-Third Annual Meeting, The American Ceramic Society, April 1, 1941 (Materials and Equipment Division). Received April 2, 1941.

the titanium determination depends on the errors of analysis of iron and vanadium.

II. Outline of Analytical Procedure

The sample may be dissolved by any conventional method as long as the final solution is at a concentration of 1 molar HCl.

(1) Determination of Iron in the Presence of Vanadium and Titanium

The iron was determined by titration with ceric sulfate after passing an aliquot portion of the solution through a silver reductor at a rate of 30 drops per minute. The reductor was then washed three times with 50 ml. of 1 molar HCl. Sulfuric acid was added to the reduced solution to obtain a 5 molar H_2SO_4 solution which was cooled to 20°C. and titrated with 0.1 N $Ce(SO_4)_2$, using orthophenanthroline as an indicator.[1] This indicator has a sensitivity to 0.05 ml. 0.01 N $Ce(SO_4)_2$. The titrated volume was then calculated to milligrams of Fe per milliliter or to any other conventional evaluation.

(2) Determination of Vanadium in the Presence of Iron and Titanium

An aliquot portion of the acidic solution was mixed with 50 ml. of 10 molar H_2SO_4 and brought to heavy SO_3 fumes to drive off the HCl. This was followed by diluting to 200 ml. by volume and cooling to 20°C. One drop of orthophenanthroline was added, and the solution was adjusted with 0.1 N $Ce(SO_4)_2$ or 0.1 N $FeSO_4$ to obtain tetravalent vanadium. (The mechanism of the valence adjustment may be expressed by the reaction,

$$Fe^{2+} + V^{5+} \longrightarrow Fe^{3+} + V^{4+}.$$

When the indicator turns red, both Fe^{2+} and V^{4+} are in the solution, but no V^{5+} can be present. The addition of $Ce(SO_4)_2$ oxidizes Fe^{2+} to Fe^{3+}, and the indicator turns greenish blue. When the indicator is greenish blue, the solution may contain Fe^{3+}, V^{4+}, V^{5+}. The addition of $FeSO_4$ reduces any V^{5+} to V^{4+} and is complete when the indicator changes to a red color showing the presence of a trace of Fe^{2+}.) The solution was boiled to destroy the indicator and immediately titrated with 0.1 N $KMnO_4$. A correction for the titration was obtained by making a blank determination on the end point. Whenever small concentrations of vanadium, that is, 5 mg. or less are encountered, a microburette is recommended.

[1] (*a*) G. H. Walden, Jr., L. P. Hammett, and R. P. Chapman, "Phenanthroline-Ferrous Ion: I, Reversible Oxidation Reduction Indicator of High Potential and Its Use in Oxidimetric Titrations," *Jour. Amer. Chem. Soc.*, **55** [7] 2649–54 (1933).
(*b*) G. H. Walden, Jr., L. P. Hammett, and S. M. Edmonds, "II, Oxidation Potentials at High Acidities and Determination of Vanadium," *ibid.*, **56** [1] 57–60 (1934).
(*c*) G. H. Walden, Jr., L. P. Hammett, and S. M. Edmonds, "III, Silver Reductor; Direct Determination of Iron in Presence of Vanadium," *ibid.*, **56** [2] 350–53 (1934).
(*d*) C. F. Fryling and F. V. Tooley, "Formation of Hydrogen Peroxide in the Silver Reductor: Microanalytical Method for Iron," *ibid.*, **58** [5] 826–31 (1936).

(3) Determination of Titanium in Conjunction with Vanadium and Iron

In the reduction of titanium by zinc, the iron and vanadium are changed to divalent state. The usual titration of titanium with ferric ammonium sulfate gave erratic results. This may be attributed to the slow oxidation of vanadium or to the incomplete reduction of titanium in the presence of vanadium. This was finally overcome by using lightly amalgamated zinc or unamalgamated zinc and titrating the reduced solution above 90°C. An aliquot of solution was treated with 50 ml. of 10 molar H_2SO_4, brought to heavy SO_3 fumes, and cooled to 20°C. The solution was diluted to 200 to 300 ml. and transferred to a hot reductor where it was allowed to remain for at least 30 minutes. The solution was slowly drained from the reductor, which had been washed with dilute H_2SO_4 and boiling water. The evaluation of the titanium concentration was then made by method (*A*) or by method (*B*) as follows:

(*A*) *Ferric Ammonium Sulfate Oxidimetry:* The final solution was titrated with 0.07 N ferric ammonium sulfate, $Fe_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$, using ammonium thiocyanate as an indicator. At the first apparent end point, which fades rather slowly, the solution should be brought to a boil and titration should then be continued until a stable end point is reached. (This procedure is necessary if the amount of vanadium present exceeds 1 to 2 mg.) The titer was then corrected for the vanadium oxidation, and the titanium was calculated according to the following equations:

$$\frac{\text{Vanadium (mg.)}}{N\ FAS^* \times \frac{50.95}{2}} = \text{ml. of } FAS^* \text{ for vanadium.}$$

$$(\text{Total ml.} - \text{ml. for V}) \times N\ FAS^* \times 80 = TiO_2 \text{ (mg.) present.}$$

(*B*) *Potassium Permanganate Oxidimetry:* The final solution was titrated with 0.1 N $KMnO_4$ until the appearance of an end point, after which the solution was heated to boiling and titration was continued to a permanent end point. At 90°C. or higher, it was found that the oxidation of vanadium went to completion rapidly. The titanium was calculated according to the following equations:

$$\frac{\text{Fe (mg.)}}{N\ KMnO_4 \times 55.85} = \text{ml. of } KMnO_4 \text{ for Fe,}$$

$$\frac{\text{V (mg.)}}{N\ KMnO_4 \times \frac{50.95}{3}} = \text{ml. of } KMnO_4 \text{ for V.}$$

$$[\text{Total ml.} - (\text{ml. for Fe} + \text{V})] \times N\ KMnO_4 \times 80 \text{ mg. of } TiO_2.$$

III. Analytical Results

Solutions of iron, vanadium, and titanium were prepared and used to make synthetic mixtures of the three elements for subsequent analyses (Table I).

Mixtures of the solutions gave the following results expressed in grams per liter. The analyses were carried out on 5-ml. samples. When the titrating volume

* FAS = ferric ammonium sulfate.

for vanadium was less than 0.8 ml., a larger quantity, that is, 10 ml. or more, was taken for analysis (Table II).

TABLE I

	To contain (gm./l.)	Analyzed (gm./l.)
Fe	50.0	50.11
V	20.0	20.10
	10.0	10.05
TiO_2	12.0	11.66
	420.0	416.00

TABLE II

ANALYSIS OF SYNTHETIC SOLUTIONS

	Mixed to contain (gm./l.)			Analyzed (gm./l.)			
						TiO_2	
No.	Fe	V	TiO_2	Fe	V	$KMnO_4$	*FAS*
1	50.11	20.1	0	50.11			
2	25.1	100.5	58.3	25.05			
3	50.11	50.25	29.15	49.6	50.4	28.0	
4	5.0	2.01	41.6	5.0	2.03	41.1	41.5
5	1.0	4.02	20.8	1.1	4.01	19.8	19.9
6	0.5	1.00	83.2	0.6	0.98	83.8	83.0
7	15.0	6.03	8.32	15.0	6.05	7.55	8.1
8	10.0	0.50	41.6	10.1	0.50	41.0	42.0

A conservative estimate of the accuracy of the vanadium procedure may be given as $\pm 1\%$. The iron determination, except for very small quantities, gave an accuracy of the same magnitude. The titanium results are quite satisfactory except for one determination which indicated that the solution might be in error. The determination of titanium with the use of ferric ammonium sulfate finally appeared to be more reliable than with $KMnO_4$.

IV. Conclusions

(1) A rapid method has been established for the determination of vanadium in the presence of iron and titanium.

(2) The determination of titanium in the presence of vanadium is discussed and improvements in analytical technique are given.

Acknowledgment

The authors wish to acknowledge the interest of J. L. Turner, Director of Research, in this investigation.

TITANIUM DIVISION
NATIONAL LEAD COMPANY
SOUTH AMBOY, NEW JERSEY

SHORT VOLUMETRIC METHOD FOR THE DETERMINATION OF IRON IN SILICATES*

BY C. M. NICHOLSON

ABSTRACT

A rapid and accurate volumetric method for the determination of iron as ferric oxide (Fe_2O_3) in silicates is described. (1) The sample is fused with a mixture of sodium carbonate and borax; (2) the melt is dissolved completely in sulfuric acid; and (3) the solution is reduced in a Jones reductor and oxidized with ceric sulfate, using orthophenanthroline as indicator. Interference by titanium, or other elements reducible by zinc, is avoided by aeration of the solution after its reduction. The estimation of titanium by difference is possible. This method is applicable to a wide range of ceramic materials and iron concentrations, and its accuracy is indicated by checking values in various standard samples.

I. Introduction

An accurate knowledge of the iron content of raw materials used in the preparation of ceramic products is important to the producer, who wishes to market a superior material, and to the consumer, who demands purity in batch ingredients. This is particularly true where fired color is a criterion. The determination of iron, therefore, is one of the commonest routine procedures in control laboratories.

Because of advances that have been made in flotation, high intensity magnetic separation, and other beneficiation methods, many raw materials that formerly were considered to be too greatly contaminated by iron have been prepared to meet the exacting requirements for fine ceramic ware. The application of such methods to individual problems frequently calls for the direct estimation of widely varying concentrations of iron. The volumetric method described here was developed as a rapid and accurate procedure for the determination of Fe_2O_3 in nepheline syenite. The author claims no originality in developing new principles, but a selection of suitable existing principles has resulted in a convenient and satisfactory method.

(1) Reagents and Apparatus

Fusion Mixture: Thoroughly mix 3 parts by weight of c.p. anhydrous sodium carbonate and 1 part of c.p. fused and powdered borax; this may be done by passing the entire quantity several times through a 20-mesh sieve; a triple flour sifter is also convenient.

* Presented at the Forty-Third Annual Meeting, The American Ceramic Society, Baltimore, Md., March 31, 1941 (General Session on Silicate Analysis). Received February 24, 1941.

Standard Ceric Sulfate[1] *Solution 0.02 N:* Use ceric ammonium sulfate, $Ce(SO_4)_2 \cdot 2(NH_4)_2SO_4 \cdot 2H_2O$ (molecular weight 628.53). As this salt generally has a purity of about 80%, dissolve 17 to 18 gm. in a 600-ml. beaker by the addition of 500 ml. of water containing 28 ml. of sulfuric acid. Stir until all is dissolved, transfer to a 1000-ml. volumetric flask, and dilute to the mark. The solution is approximately $0.02N Ce^{+4}$ and 0.5 molar in free sulfuric acid. The solution must be at least 0.5 molar in free sulfuric acid to keep the ceric sulfate in solution. *Standardization:* Weigh accurately 0.0335 gm. of sodium oxalate and place in a tall 250-ml. beaker. Dissolve by adding 20 ml. of hydrochloric acid diluted to 95 ml. with water; stir until dissolved and add 5 ml. of 0.005 molar iodine monochloride as a catalyst and heat to just 50°C. Use a thermometer as a stirring rod and, after the addition of 3 drops of 0.025 molar orthophenanthroline indicator, titrate with standard ceric sulfate until the solution is pale blue and there is no return of any pink color after an interval of 1 minute. If the temperature falls below 45°C., reheat the solution to 50°C. Determine and deduct the blank for indicator.

Calculation of Normality: The sodium oxalate used is equal to 25 ml. of 0.02*N* ceric sulfate, and normality equals

$$\frac{0.02 \times 25.00}{\text{Volume of ceric sulfate}}.$$

One ml. of 0.02*N* ceric sulfate is equivalent to 0.001597 gm. of Fe_2O_3. The titer for TiO_2 is almost the same as for Fe_2O_3. Standard ceric sulfate solutions may be kept in glass-stoppered bottles indefinitely without change in normality.

Sodium Oxalate: U. S. Bureau of Standards sample for standardization.

Iodine Monochloride: Dilute 10 ml. of 0.5 molar solution to 1000 ml.; preserve in a brown glass-stoppered bottle in a dark place.

Orthophenanthroline Ferrous Complex[2]*: 0.025N:* This solution may be purchased ready for use.

Ferric Sulfate Solution: Boil a mixture of 250 ml. of distilled water and 250 ml. of 1:1 sulfuric acid; add 37.5 gm. of pure ferric sulfate.

Amalgamated Zinc[3]*:* Dissolve 11 gm. of mercuric chloride in 100 ml. of concentrated hydrochloric acid. Cover 250 gm. of 20-mesh zinc with distilled water in a heavy 1000-ml. flask. Add the mercuric chloride solution slowly and shake the contents for 2 minutes. Pour off the solution and wash the zinc thoroughly, first with hot tap water and finally with distilled water.

Jones Reductor: A reductor having a large capacity for amalgamated zinc is recommended. The zinc should be retained by a perforated porcelain plate and a plug of glass wool. The reductor should be filled with distilled water and covered when not in use.

Microburette: A self-filling microburette, calibrated to 0.01 ml. and having a capacity of 2 to 5 ml., is recommended. Burettes of this type are fitted with a 2-way stopcock and equipped with a glass-stoppered and vented reservoir.

II. Procedure

Grind a representative sample to an impalpable powder in an agate mortar and dry at 100° to 105°C. Weigh a 1.000-gm. sample and thoroughly mix with 7 gm. of sodium carbonate-borax fusion mixture in a 30-ml. platinum crucible. Heat the closely covered crucible slowly at first to prevent spattering, gradually increasing the temperature to the full heat of a Méker burner or to about 1700°F. in an electric muffle. A clear melt should be obtained in about 10 minutes. Using platinum-tipped crucible tongs, swirl the crucible as it cools to spread the melt in a thin layer. Digest the cover, crucible, and contents in 150 ml. of distilled water and 40 ml. of 1:1 sulfuric acid in a 600-ml. beaker covered with a watch glass. Solution of the melt is rapid, but it may be hastened by heating on a hot plate. When solution is complete, remove and wash the watch glass and crucible and cover thoroughly with distilled water.

Reduce the solution in a Jones reductor. Draw the solutions through at a rate of about 100 ml. per minute and in the following order: 25 ml. or more of 10% sulfuric acid, the approximately 200 ml. of solution containing the sample, 25 ml. or more of 10% sulfuric acid, and finally 100 ml. or more of distilled water. If the reductor has been idle, it should be washed before use by drawing through 100 to 200 ml. of 10% sulfuric acid followed by 100 to 200 ml. of water.

Transfer the reduced solution from the suction flask back into the original 600-ml. beaker. Add 1 drop only of orthophenanthroline ferrous complex as indicator. Titrate from a microburette with 0.02 *N* ceric sulfate solution to the disappearance of the pink color imparted by the indicator.

(1) Aeration Procedure[4]

To reoxidize titanium (and other interfering substances reducible by zinc), add 50 ml. of water, freshly aerated and in equilibrium with the air, to the solution from the reductor. Stir vigorously for 2 minutes and titrate.

(2) Total Iron and Titanium and Titanium by Difference

Determine the percentage of Fe_2O_3 in one sample after aerating the reduced solution. Weigh, fuse, and dissolve a second sample. Pass the solution through the reductor and collect under 15 ml. of ferric sulfate solution in 35 ml. of water. Use distilled and reboiled water for solutions and washing. Transfer carefully to the beaker, and titrate with a minimum of agitation. The value obtained represents Fe_2O_3 plus interfering

[1] G. Frederick Smith, Ceric Sulfate, Vol. I, 3d ed., August, 1935. G. Frederick Smith Chemical Co., Columbus, Ohio. 64 pp.

[2] G. Frederick Smith, Orthophenanthroline. G. Frederick Smith Chemical Co., Columbus, Ohio. 35 pp.

[3] J. M. Jarmus and W. R. Willets, "Analysis of Paper Ash Containing Titanium Pigments," *Paper Trade Jour.*, pp. 7–9 (Jan. 4, 1934).

[4] Emil Truog and R. W. Pearson, "Iron Determination in Presence of Titanium Using Zinc Reduction," *Ind. Eng. Chem., Anal. Ed.*, **10** [11] 631–32 (1938); *Ceram. Abs.*, **18** [8] 223 (1939).

substances. If titanium is known to be the only interfering substance, subtract the value for Fe_2O_3 from that for Fe_2O_3 and TiO_2 combined to obtain the percentage of TiO_2.

(3) Determination of Blank

If the highest quality reagents are used, the blank is due largely to the amount of standard solution required for the end point. The blank should be determined on a sample of known iron content.

III. Discussion of Procedure

The fusion mixture of 3:1 sodium carbonate and borax completely prevents the precipitation of silica when the melt is dissolved in dilute sulfuric acid. This is a distinct advantage in that samples may be brought directly into solution and ready for reduction in one simple operation. Seven grams of fusion mixture and 40 ml. of 1:1 sulfuric acid are sufficient for a 1-gm. sample containing up to 70% of silica. For 1-gm. samples of materials containing more than 70% of silica, the quantities of fusion mixture and acid should be increased. For silica sands, 10 gm. (or more) of fusion mixture and up to 60 ml. of dilute acid will afford complete solution.

Platinum[5] dissolved during fusion is reduced to the metal in the upper part of the reductor and therefore does not interfere in the titration of the solution that passes through.

Amalgamated zinc[6] reduces such substances as iron, titanium, chromium, molybdenum, vanadium, uranium, and columbium. All are extremely unstable except iron and quadrivalent vanadium or uranium. Of all the possible interfering substances in the determination of iron after zinc reduction, only titanium is ordinarily present in an appreciable quantity in the usual run of ore samples. Because trivalent titanium is unstable, it is readily reoxidized selectively to tetravalent titanium by aeration. Iron reduced by zinc is quite stable and is not appreciably oxidized[4] even by excessive aeration. To determine total iron and titanium quantitatively after zinc reduction, it is necessary to collect the reduced solution under an inert gas or a solution of ferric sulfate. The latter completely oxidizes the titanium, producing an equivalent amount of ferrous sulfate.

One drop (or at the most two drops) of orthophenanthroline indicator provides sufficient color to titrate the reduced solution with ceric sulfate. The end point is sharp and distinct and care should be taken that it is not overstepped. A fraction of a drop of ceric sulfate solution changes the last trace of pink to pale blue as the end point is reached.

IV. Accuracy and Application of Method

The accuracy of the method has been established by checking the values in U. S. Bureau of Standards standard samples and also by the assay of umpire samples submitted to and analyzed by other laboratories. Some results are given in Table I.

TABLE I

Sample No.	Fe_2O_3 (%) Present	Fe_2O_3 (%) Found	$Fe_2O_3 + TiO_2$ (%) Present	$Fe_2O_3 + TiO_2$ (%) Found	TiO_2 by difference (%)
70	0.03	0.031	0.032		
99	0.067	0.067	0.084	0.083	0.016
81	0.072	0.073	0.167	0.168	0.095
76	2.38	2.38	5.59	5.52	2.14
5*	0.072	0.072	0.072		

* Umpire.

Figure 1 shows that a wide range of percentages of iron can be determined accurately without modification of the method other than the size of the sample taken or the strength of the ceric sulfate solution used.

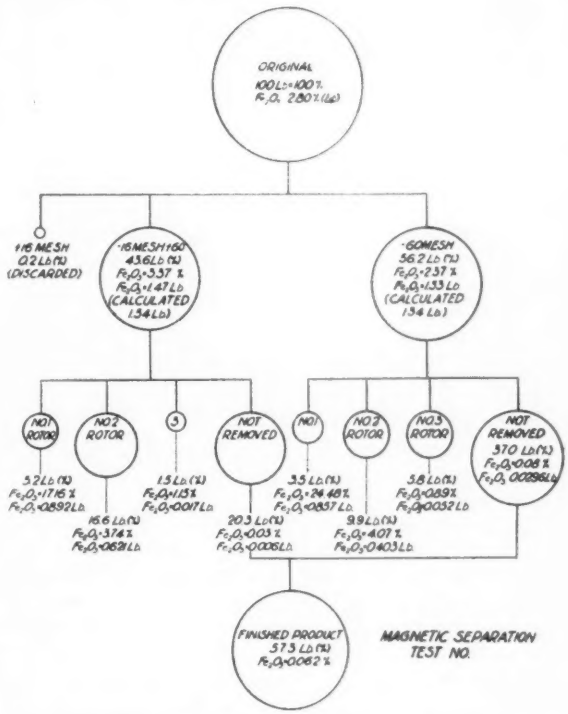

FIG. 1.—Magnetic separation test; weight of Fe_2O_3 in heads (by analysis) checks weight by calculation.

In a magnetic separation test, head samples and all products were weighed and assayed for Fe_2O_3. The percentages of iron varied from 0.03 to 24.48%. The weight of iron in each sample was calculated by multiplying the percentage of iron by the weight of the sample. The accuracy of iron assays is shown by a comparison of the calculated values and the analyzed values of each mesh size before separation. For example, the plus 60-mesh split analyzed 3.37% of Fe_2O_3 before separation, or 1.47 lb. of the ferric oxide contained in 100 lb. of the "original." The calculated value of 1.54 lb. was obtained by adding the proportional amounts of ferric oxide found by analyzing the various products

[5] W. F. Hillebrand and G. E. F. Lundell, Applied Inorganic Analysis, p. 104. John Wiley & Sons, Inc., New York, 1929. 929 pp.; *Ceram. Abs.*, 9 [1] 68 (1930).

[6] *Ibid.*, p. 103.

of separation. The check is even closer in the minus 60-mesh split, that is, 1.33 lb. by analysis and 1.34 lb. calculated.

V. Summary

(1) A method is described that was developed primarily for the rapid and direct evaluation of Fe_2O_3.

(2) The possible interference of moderate quantities of titanium or other substances normally encountered is effectively avoided by aeration.

(3) A convenient determination of titanium by difference is possible.

(4) A single assay can be performed in about 30 minutes and, with plenty of platinum and other equipment, several may be run off in one hour.

American Nepheline Corporation
Rochester, New York

APPARATUS AND METHOD FOR THE DETERMINATION OF THE SPECIFIC GRAVITY OF FINE POWDERS*

By W. C. Knoblaugh and A. J. Boyle

Abstract

A description of the apparatus and method used to determine the specific gravity of finely powdered clinkers is given, and the results are tabulated.

I. Introduction

The following description is presented of the apparatus and method used for determining the specific gravity of finely powdered clinkers. The principle of the Jackson apparatus[1] is used, but this method has been modified at various points as will be described. An effort has been made to increase the speed of the determination without sacrificing its accuracy.

Because of the hydration and solubility of the refractory clinkers used, which are composed principally of lime and periclase, it was necessary to use media other than water in the determination. The selection of toluene was accordingly made on the recommendations of other investigators. Owing to the high coefficient of expansion of organic liquids, pycnometer methods give erroneous results unless the specified calibration temperatures are maintained. In the apparatus described, a constant temperature must be maintained only for the duration of a test, although it may vary several degrees from the calibration temperature. The source of error that is caused by the inclusion of air in the pores of the clinker is minimized by boiling the toluene in contact with the sample. Inasmuch as the toluene is a portion of a measured volume, any loss may be avoided by the use of a reflux condenser. Because the coefficients of expansion of the glass units of the apparatus compare favorably, the volumes are relative rather than absolute, and this affords a minimum of error and a maximum of convenience. The use of a 20-gm. sample and 50 ml. of toluene serves to increase the accuracy over certain pycnometer methods. The limiting error, therefore, is the accuracy with which the sample is weighed and the burette is read. In routine work, using the apparatus described, six complete determinations may be made per hour with only one weighing needed for each determination. Table I shows that this method gives values in close agreement with those of Dana,[2] and the results have been found to be reproducible to within 0.2%.

Table I

Screen size	Boiling time (min.)	Sp. gr.	Dana* (sp. gr.)
		Quartz	
−48 + 150	5	2.66	2.653–2.660
		Dolomite	
−48 + 150	5	2.83	2.80–2.90
		Celestite	
−48 + 150	5	3.96	3.95–3.97

* Specific gravity values from Dana (see footnote reference 2).

II. Apparatus

The apparatus, shown in Fig. 1, consists of two water-jacketed, 50-ml. burettes, a 600-mm. water-cooled reflux condenser, three 50-ml. Pyrex-brand volumetric flasks, two beakers, a thermostatically controlled hot plate, and a supporting stand.

III. Procedure

The specific gravity is determined as described. Before a series of determinations is begun, however, free toluene is refluxed for approximately 3 minutes to wet the sides of the condenser, the heat is withdrawn, and the toluene is allowed to drain into the cooling flask (the two flasks used will be referred to as flask A and flask B). This procedure is merely a calibration pre-

* Received June 19, 1941.

[1] D. T. Jackson, "Apparatus for Direct Determination of Specific Gravity of Cement," *Jour. Soc. Chem. Industries*, **23** [11] (June 15, 1904).

[2] W. E. Ford, Dana's Textbook of Mineralogy, 4th ed. pp. 471, 516, and 750. John Wiley and Sons, New York N. Y., 1932.

TABLE II

Material	Sample size (gm.)	Boiling time (min.)	Specific gravity
Dolomite	20	3	2.85
"	"	3	2.85
Clinker A	"	3	3.52
" "	"	3	3.52
Clinker B	"	3	3.54
" "	"	3	3.53
Chrome ore	"	3	4.44
" "	"	3	4.44

TABLE III

Clinker A

Screen size	Boiling time (min.)	Specific gravity
−100 + 150	5	3.53
−100 + 150	10	Bump
−100 + 150	20	Bump
− 48 + 150	None	3.39
− 48 + 150	5	3.53
− 48 + 150	10	3.53
− 48 + 150	20	3.53
− 20 + 150	5	3.54

caution as a thin film of the liquid remains after each determination in the reflux condenser. The apparatus is now prepared to receive the first sample. Enough clinker to fill approximately one quarter of the flask bulb (about 20 gm.) is weighed into flask B. The burette is filled with toluene, the temperature is permitted to become constant, and 20 ml. of toluene are run into flask B. Flask A is removed, flask B is connected to the reflux condenser, and heat is applied until an obvious bumping occurs; this indicates that the included air has been removed and that further boiling is unnecessary. The time required for this step (Table II) is approximately 3 minutes. Flask B is allowed to cool in place long enough to drain the condenser. When the neck of the flask becomes cool enough to handle, flask B is quickly transferred to the water-bath beaker (Fig. 1) directly under the burette. The beaker is connected in series with the water jacket of the burette. After flask B has stood for a period of 3 minutes, it is filled to the 50-ml. mark with toluene from the burette. The temperature of the toluene is considered to be identical with that of the water when no further shrinkage can be noted with relation to the calibration mark. A few more drops are added from the burette to bring the level to the calibration mark, and the burette reading is made.

IV. Results

As will be observed from the data (Table III), −48 + 150-mesh seems to be the optimum grain size. Material that is finer than this has a tendency to creep and to resist wetting, and coarser material gives low results. The specific gravity is calculated from the following formula:

$$\text{Sp. gr.} = \frac{\text{weight}}{\text{volume displaced}}.$$

Example: Clinker X, sp. gr. $= \dfrac{40.00}{50 - 38.65} = \dfrac{40.00}{11.35} = 3.53.$

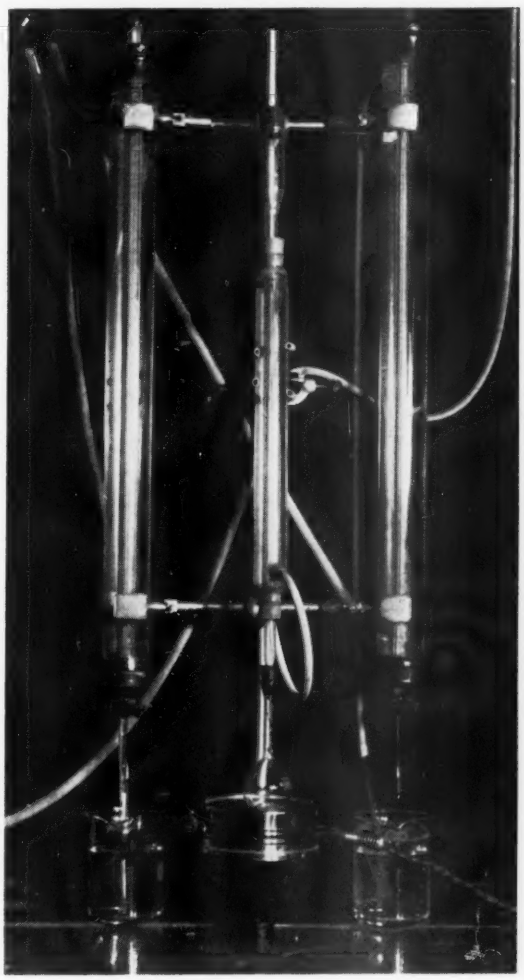

FIG. 1.

BASIC REFRACTORIES, INCORPORATED
MAPLE GROVE, OHIO

PURE ALUMINA REFRACTORIES BONDED WITH LUMNITE CEMENT*

By Paul G. Herold and J. L. Hoffman

Abstract

Mixtures of various grain sizes of corundum and Lumnite were formed by tamping the slurry in brass molds. Pyrometric cone equivalent determinations were made, which showed that free silica is extremely detrimental to refractoriness. The best refractory sample seemed to be the one composed of a large proportion of fine-grained corundum, bonded with 5 to 12½% of Lumnite cement.

I. Introduction

Users of refractories are constantly demanding better products, a fact which may explain the increasing interest in bodies having a high alumina content. A study of the properties of pure alumina or a commercial type of corundum indicates that desirable special refractories might be made from these materials. The problem of bonding such material satisfactorily was studied, and a high-alumina cement was used for the test.

The high-alumina cement, which is marketed in this country as Lumnite, is essentially a rapid-setting calcium aluminate containing approximately 15% of iron oxides. Its hydraulic setting properties are similar to those of the calcium silicate cements, which have been used to bond various materials, such as olivine,[1] clay, and grog.[2]

The materials used in this investigation were calcium aluminate cement, 8-mesh and 200-mesh corundum manufactured from bauxite, and 200-mesh quartz. The P.C.E. values of this sample were determined.

The usual test cones, made from the mixes shown in Table I, were compared with standard cones using the A.S.T.M. standard heating schedules.

Table I

Cement (%)	Corundum (%)	Quartz (%)	P.C.E.
100	0	0	6
87.5	0	12.5	9–10
75	0	25	5–6
62.5	0	37.5	4–5
50	0	50	4–5
37.5	0	62.5	5
25	0	75	17–18
12.5	0	87.5	20
0	0	100	36
87.5	12.5	0	8–9
75	25	0	13–14
62.5	37.5	0	18
50	50	0	23
37.5	62.5	0	34–35
0	100	0	42 (est.)
50	25	25	10
25	25	75	12–13
25	75	25	15–16
13	43.5	43.5	16–17

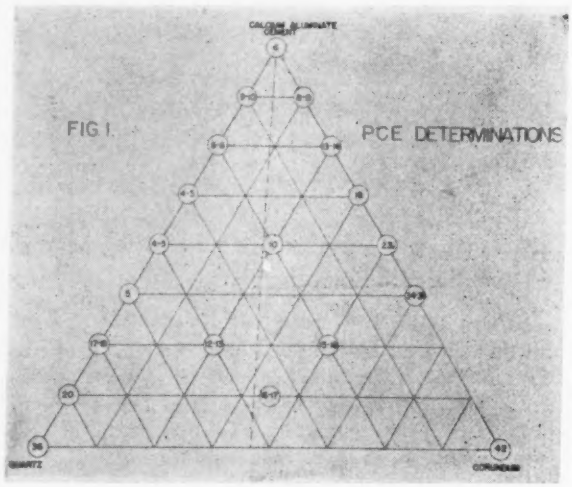

Fig. 1.—P.C.E. determinations.

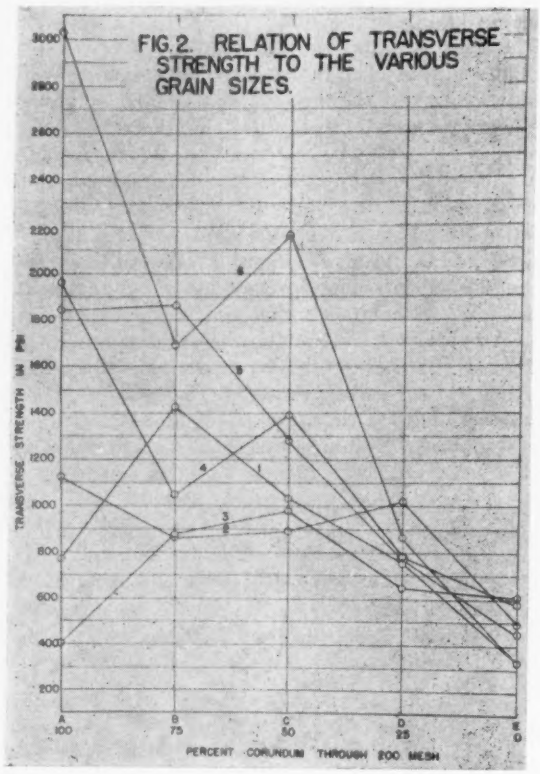
FIG. 2. RELATION OF TRANSVERSE STRENGTH TO THE VARIOUS GRAIN SIZES.
TRANSVERSE STRENGTH IN PSI
PERCENT CORUNDUM THROUGH 200 MESH

Fig. 2.—Relation of transverse strength to various grain sizes.

* Presented at the Forty-Third Annual Meeting, The American Ceramic Society, Baltimore, Md., April 2, 1941 (Refractories Division). Received April 3, 1941.

[1] A. F. Greaves-Walker and R. L. Stone, "Study of Bonding Agents," *N. C. State Coll. Record*, **38** [1] 44–58 (Sept., 1938).

[2] R. T. Giles, "Investigation of Certain Properties of Refractory Concrete," *Bull. Amer. Ceram. Soc.*, **18** [9] 326–32 (1939).

These data indicate that mixtures of 62.5% of corundum with cement give a high degree of refractoriness (cone 35 or greater) and that free silica has a marked detrimental effect on the refractoriness of mixtures of corundum and calcium aluminate cement (see Fig. 1).

The grain sizes and the proportions of corundum to cement were varied as shown in Table II.

TABLE II

Body	Corundum (%)	
	Through 200-mesh	Through 8-mesh
A	100	
B	75	25
C	50	50
D	25	75
E	100	

The proportions of corundum used were, respectively, (1) 62.5, (2) 75.0, (3) 85.0, (4) 87.5, (5) 92.5, and (6) 95.0%. The symbol, A5, therefore, would indicate a body composed of 92.5% of corundum and 7.5% of cement; the corundum content would be composed of 100% material through 200-mesh.

Six test pieces, 1 by 1 by 6 in. in size, were made from each batch by mixing 12 to 15% of water to the dry cement-corundum mixture. This concrete was tamped into brass molds, using a hand pressure of not more than 15 lb. according to A.S.T.M. recommendations for concrete test specimens. The test pieces were removed from the brass molds at the end of 24 hr., during which time they were covered with water-saturated cloths so as to supply enough water to allow the cement to set. The bars were dried in air for 72 hr. and at 110°C. for 8 hr.

All of the bars were fired to cone 15 in an oil-fired kiln and tested for shrinkage, absorption, and transverse strength. The drying shrinkage and transverse strength of the unfired material were also determined on every batch. These data are shown in Table III (the dry shrinkage was zero throughout the test).

Figures 2 to 7, inclusive, have been plotted to show trends when composition and grain size are changed simultaneously.

II. Analysis of Data

As the grain size of the corundum decreases, the transverse strength is found to increase, although this fact does not hold in all cases. Small cracks, for example, are caused by a rapid evolution of water from the cement during the firing process.

An increase in the amount of cement bonding the corundum generally causes a decrease in the fired transverse strength with accompanying increases of strength in the unfired condition (see Fig. 3). This decrease in strength is apparent until between 15 and 25% of cement is added, after which the strength increases.

Most of the bodies studied expanded on firing to give rather high absorptions. As the amount of cement is increased from 15 to 25%, the expansion increases and then decreases as more cement is added. Expansion and, consequently, absorption were more pronounced in those bodies containing a large proportion of fine grains (see Figs. 4 and 5)

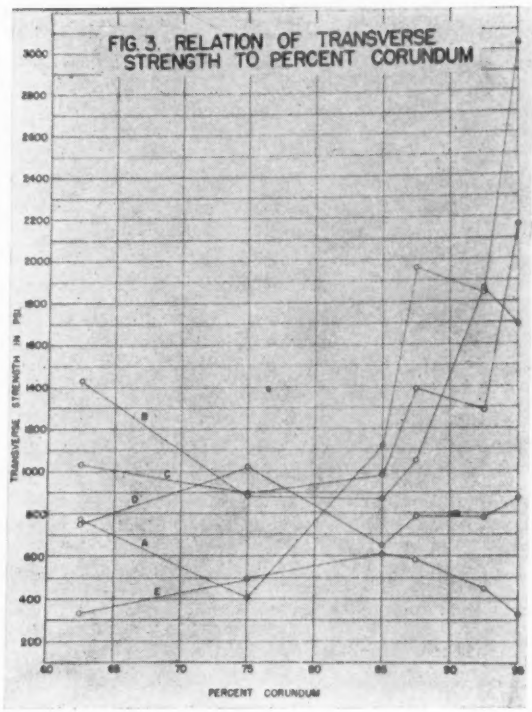

FIG. 3.—Relation of transverse strength to percentage of corundum.

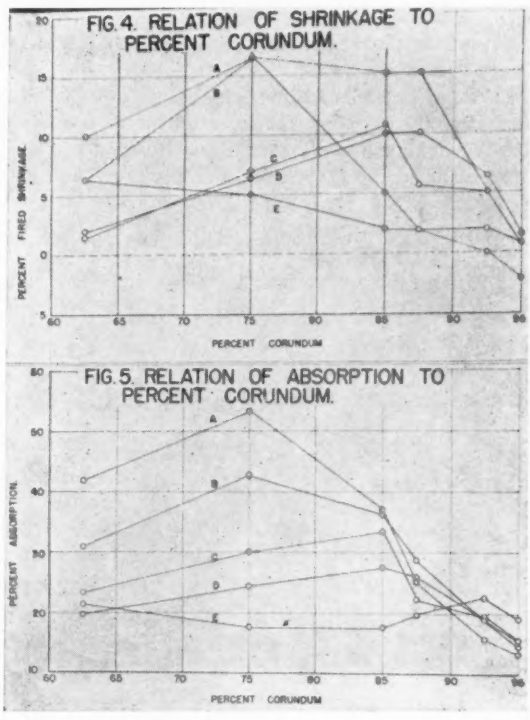
FIG. 4. RELATION OF SHRINKAGE TO PERCENT CORUNDUM.
PERCENT FIRED SHRINKAGE
PERCENT CORUNDUM
FIG. 5. RELATION OF ABSORPTION TO PERCENT CORUNDUM.
PERCENT ABSORPTION
PERCENT CORUNDUM

FIGS. 4 AND 5.—Relation of shrinkage and absorption to percentage of corundum.

TABLE III

Batch No.	Transverse strength (unfired)	Transverse strength (fired)	Fired shrinkage (%)	Absorption (%)
A1	1294	770	−10.0	41.8
A2	677	403	−17.65	53.0
A3	694	1120	− 5.0	36.8
A4	1142	1960	− 3.8	25.0
A5	468	1840	0.0	15.6
A6	187	3025	+ 4.3	13.2
B1	1465	1425	− 7.6	30.9
B2	1813	880	−17.65	42.7
B3	1212	867	−15.0	36.0
B4	1013	1049	−15.0	36.0
B5	900	1865	− 5.0	18.8
B6	543	1690	− 1.2	14.5
C1	1672	1031	− 2.6	23.2
C2	1330	893	− 8.8	30.0
C3	900	979	−11.1	33.2
C4	937	1391	− 6.2	22.2
C5	785	1280	− 5.0	19.3
C6	813	2160	− 1.2	15.3
D1	1725	750	− 3.8	19.6
D2	1565	1017	− 7.6	24.2
D3	1500	647	−10.0	27.2
D4	1725	782	−10.0	25.7
D5	907	776	− 7.6	18.7
D6	702	867	− 2.6	15.1
E1	1697	330	− 7.6	21.3
E2	1610	495	− 5.0	17.4
E3	1135	605	− 3.8	17.1
E4	900	577	− 3.8	19.4
E5	600	454	− 3.8	22.4
E6	330	330	− 2.7	19.0

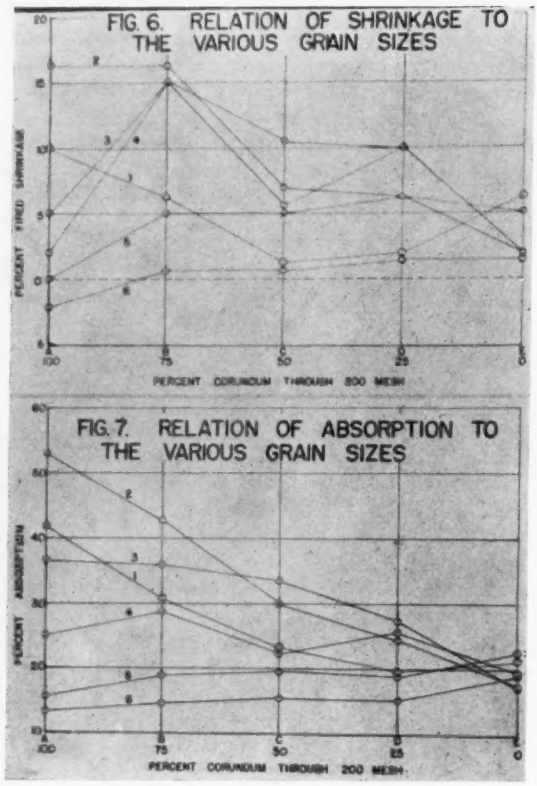
FIG. 6. RELATION OF SHRINKAGE TO THE VARIOUS GRAIN SIZES
PERCENT FIRED SHRINKAGE
PERCENT CORUNDUM THROUGH 200 MESH
FIG. 7. RELATION OF ABSORPTION TO THE VARIOUS GRAIN SIZES
PERCENT ABSORPTION
PERCENT CORUNDUM THROUGH 200 MESH

FIGS. 6 AND 7.—Relation of shrinkage and absorption to various grain sizes.

III. Conclusions

Calcium aluminate cement, used as a bonding agent for pure corundum, has excellent working properties in all of the proportions studied. Although no difficulties were incurred in drying when the humidity was under control, a weak shell and cracks were formed when the bars were dried too rapidly. Both the green and fired ware had good strength and sharp edges. The fired bars ranged from a rather soft light mass to a brittle dense mass.

For general refractory use, it seems that the most satisfactory bodies are composed of 100% of 200-mesh corundum combined with 12.5 to 7.5% of calcium aluminate cement, 75% of 200-mesh and 25% of 8-mesh corundum combined with 7.5 to 5% of calcium aluminate cement, and a 50–50 mixture of the grain sizes bonded with 5% of cement. For some uses, the greatest detriment is the high absorption.

DEPARTMENT OF CERAMIC ENGINEERING
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THE USE OF PATTERN IN CERAMICS*

BY CARLTON ATHERTON

ABSTRACT

If structural ornament is used properly, it is a living thing and an integral part of ceramic ware. The purposes and various types of decoration, the direct application of patterns, and the role of pattern versus that of decoration are discussed. The fundamental principles of decoration are given in a set of suggestions to the decorator.

I. Introduction

Deep within all of us there is a strong desire for patterned surfaces. Whether this yearning is a psychological or physical aversion to blank spaces, whether it is a characteristic deep in the psyche of the race, or has its roots in some other cause, it is common to all of us. In primitive man, this desire amounts to a positive craving; consequently, there are few undecorated primitive pots to be found. Ornament is also completely influenced by the group-thought of any time or people, and it is interesting to note the simplicity of ornamental details used.

* Presented at the Forty-Third Annual Meeting, The American Ceramic Society, Baltimore, Md., April 1, 1941 (Art Division). Received May 27, 1941.

These motifs are often repeated many times and establish an apparently elaborate pattern, but invariably the unit itself is simple and intrinsically complete. It establishes itself as a relative part of the whole through the rhythm of necessary repetition. On examination, the pottery of primitive man also shows how he almost unerringly related the ornament to the shape. He seems to have had an instinctive sense of "rightness," which is not so apparent in modern man. The decoration is an integral part of the whole and not something merely applied to the surface.

The consideration of any art form and its appreciation presupposes sufficient leisure and economic freedom for its manufacture as well as its enjoyment. There is, then, a time element that is important from both of these standpoints. The eye should be invited to wander over the piece and should be led from one detail to another. An opportunity should be furnished for fresh viewpoints and an invitation for sustained appreciation.

II. Types of Decoration for Ceramic Ware

All ornamental designs may be divided into two great classes, namely, structural and applied. Structural ornament is present in the material itself, such as irregular coloring in the clay, or it develops naturally from working the material, such as lines left by the potter's fingers in throwing. The primitive potter quickly realized the decorative possibilities of the effects produced naturally in working clay. Early coiled pottery, which relies for decoration on the coils themselves and the thumbprints of the potter, bears witness to this. An examination of some of the ware of the Indians of the southwest will show how this treatment was utilized to advantage. Structural ornament is a living thing, growing as the pot grows and remaining an integral part of it. Always controlled by the generating lines of the piece, the structure gives it coherence, unity, and a sense of space, time, and logic.

Applied ornament is self-explanatory; it is not inherently manufactured with the piece but is a later embellishment of the material or of its surface. This type of decoration may be used in innumerable ways and at various stages as the work progresses. For instance, modeling, stamping, sprigged decoration, carving, slip decoration, stenciling, and painting may be used on the unfired ware. After the biscuit firing, the ware may be painted or printed with underglaze colors; soluble salts may be applied; and transfer patterns in underglaze stains or underglaze crayons may be used as well as any number of glaze techniques. If the ware has been glazed, it may be decorated by painting or printing with overglaze colors, decalcomania transfers, ground laying, tinting or stenciling with an air brush, raised enamel, or gilding. The techniques and combinations of them, which are almost without number, are important, but they are not pertinent to this discussion. The relation of the ornament to the piece, however, is vital. Technical skill should not be neglected, for no decoration can be direct unless there is a perfect coordination between the mind of the decorator and the instrument used. The instrument should become an extension of the mind and not a barrier between it and its expression. The tool cannot become an interference or the pattern will be marred.

III. The Purpose of Decoration

Because ornament is designed to form a pattern that is regular or is used as a general composition, the rhythms and the interrelations of the background on which the decoration is laid are as important as the functions of the ornamental details themselves. It is this structure or reciprocal quality that gives coherence, unity, and a sense of space and time to the ornamental pattern. The painted ware of the western Indians shows many fine examples of this type of pattern.

All ornament must be seen not once but many times, and the longer the element of time appreciation that is established within the pattern the more enduring its interest becomes. It must not be so involved as to be incomprehensible, but it must give the appearance of simple logic and the impression of having grown from within naturally and with little effort on the part of the potter. The late Dr. Binns said,

> To make pieces merely as an exhibition of skill is both shortsighted and in bad taste. . . . .It may be laid down as a precept that a production in the nature of a tour-de-force, an object which simply incites wonder at the skill of the worker, is both undignified and meretricious. . . . . Art will always conceal effort. Just as the poet is at his best when he clothes sublime thought in simple words, so the craftsman glorifies his vocation when he makes use of means which appear to be within the reach of every observer.

Decoration should play over the surface in a way that prolongs interest in the piece but not in itself. The observer should be conscious, not of decoration on a pot, but of a decorated pot. It is the form, the piece of pottery, which is important and not the ornament applied to it. The decoration should accentuate the form, become a part of it, and persuade further investigation on the part of the observer; it should incite curiosity to explore, to move around it, or to pick it up for closer examination. Decoration is fulfilling its purpose when it creates a long-time interest in the object decorated and when it invites use. Ornament, no matter how beautiful in itself, must be content to be only a part of a larger whole; it cannot exist independently of the mother form. Occasionally, with complete understanding on the part of a sensitive potter, it can sing out a melody, but even then it must be in the nature of counterpoint, becoming the melodic accompaniment of a larger harmony. It is important to remember that each shape demands special consideration and calls for treatment of its own. There has been too much drawing-board decoration; the patterns made may be fine in themselves, but the surface of each pot has a character of its own quite different from that of a flat piece of paper. This ever-changing, ever-moving surface is the outward expression of the space occupied by the form itself. Even the slightest change in that form will completely alter the character of its surface, a surface which moves according to the directing and generating lines and to the character of the mass.

(1941)

IV. Direct Application of Ornament

For this reason and because it is best to use the materials and tools for experiment that will be employed in the finished ware, the finest results are obtained by working directly. It is in this way only that the character of the form can be realized. Many artists hesitate to work directly for fear of spoiling a piece; and if they do work directly, they are inhibited by the same fear. To overcome this handicap, some pieces can be thrown on the wheel for experimental use. A release from tension, borne of fear, comes almost at once with the knowledge that the decoration is being applied simply for practice. Some of the finest work probably will be done in this way, for the spontaneity and directness engendered by this freedom is difficult to recapture. There will be present the same freshness that may be seen in the sketch book of the painter, and surprisingly expressive results are often obtained. If some shapes are biscuited, they may be decorated with underglaze color or slip, which can be washed off and used over and over again. The potter thus becomes acquainted with his tools and materials, his attitude of uncertainty will change, and a freedom will result which will more than repay him for the time spent. He will also be building a vocabulary of decoration because each pattern made suggests new ones and each motif brings new ideas.

V. Role of Potter versus Decorator

Whether or not the potter becomes a fine decorator depends, naturally, on his sensitivity and discernment. Some individuals and peoples are equipped with a natural aptitude for decoration; in others, it is apparently lacking. The Persians, with their versatile and logical minds, were endowed with a special sense of decorative fitness. They, perhaps more than any other people, have experienced the joy and exuberance of patterned surfaces. Spain received this wonderful heritage from Persia. The Italians, who were not slow to appropriate this heritage, produced ware that was both ceramic and virile in pattern. There is, however, a sad lesson to be learned from these Italian artists. The decorations slowly became more important to them than the ware on which they were painted; the decorator took precedence over the potter. This trend was further heightened by the tremendous influence of the Renaissance painters, and in the sixteenth century, ware was being made solely as a vehicle for painted pictures. These fine pictures might have been moving works of art on a flat plane, but on the changing surface of a pot or bowl, they became meaningless, distorted, and illogical, and the form of the piece was completely destroyed.

VI. Suggestions to the Decorator

It is always dangerous to make rules for the production of any form of art, and this is especially true for decoration that is applied to pottery. Each piece that is to be decorated becomes a unique problem to be solved with sensitive understanding by a discriminating potter. There are certain fundamental principles, however, which generally apply. These considerations, strangely enough, seem almost too obvious to mention, but they are being constantly neglected. The ornament, for example, should be appropriate to the form on which it is placed, that is, the scale of the pattern should have a definite relation to the size and shape of the piece. The choice and modality or form of the motif, moreover, should in no way conflict with the function of the piece. The ornament also should never deny the nature of the material; it should enhance its individuality by calling attention to those qualities that are peculiar to it. "Decoration should vitalize the surface—it should not consume the forms and absorb them to its own advantage. Ornament should accentuate the form by directing and arresting attention on the generating lines, the lines which regulate the mass. There must be an organic relation between ornament and the structural lines of the object decorated. Ornament should do little more than continue the thought set forth in the construction."

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CLAYS AND CLAY BODIES FOR ART PURPOSES*

By C. C. Engle

Abstract

The types of clays and other body ingredients for use by the art potter are discussed; the analyses of physical and chemical characteristics of two of these clays are given; and various body materials and blends are suggested.

I. Introduction

In the development of a line of clays suitable for the use of the ever-increasing number of persons who wish to create something out of clay, it must be kept in mind that there are many methods of forming the ware and many tastes and temperaments to be satisfied. The clays concerned here are chiefly those that are being used by the clay industries, both ceramic and non-ceramic.

II. Body Preparation

A body containing a large percentage of ball clay and

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calcine, a small percentage of china clay, and small percentages of feldspar, whiting, and barium carbonate (without flint) will stand terrific punishment. If every potting rule is ignored and if the kiln flame is permitted to impinge directly onto the piece, it can be demonstrated that nothing serious will happen to a biscuit piece. This particular body is suitable for making ware by any of the forming methods that may be used.

A wider range of clays may be used for hand-pressed ware than for ware that is thrown on the wheel. For building or coiling, almost any clay with reasonable plasticity and other suitable properties may be used.

A natural clay of the semiball-clay type is satisfactory if it is used with any of the ordinary methods. This clay is composed of a good percentage of fine silica, and the clay matrix has a fine particle pattern. Other characteristics are (1) linear dry shrinkage, 5 to 7%; (2) plasticity, good; (3) water of plasticity, 25 to 35%; (4) cross-breaking strength, 175 to 250 lb.; (5) residue on 100-mesh, preferably none; and (6) residue on 200-mesh, mainly fine silica (5 to 10%). The firing characteristics for cones 02, 2, and 8 are as follows:

	Fired at		
	Cone 02 (2003°F.)	Cone 2 (2075°F.)	Cone 8 (2237°F.)
Fired shrinkage (%)	3–4	4–5	6–7
Absorption (%)	7–9	6–8	0–1
Fired color	All of desired tone		

One such clay has essentially the following properties:

Chemical analysis	(%)		(%)	Rational analysis	(%)
Silica	73.63	Iron	1.20	Clay substance	35.0
Alumina	16.57	Soda	0.15		
Lime	0.11	Potash	1.50	Quartz	47.0
Magnesia	0.45	Ignition loss	5.35	Feldspar	18.0
Titania	1.18				

The degree of acidity in a clay is represented by the symbol pH, which indicates the concentration of hydrogen ions or acid formers that are present. This particular clay shows a pH of 4.7 to 5.0. Most natural clays are under the neutral point of 7, and the majority vary from 4.0 to 5.5. The writer does not mean to imply that a clay which has these raw and fired properties would necessarily have the same chemical analysis that is given here because all clays are diverse and complex materials. A clay is not a manufactured product; it is a product which nature has been remaking and transforming for long periods of time.

II. Specific Properties of Suitable Clays

(1) Physical

Ball clays alone cannot be used for making art pottery; if they are any good as ball clays, they must be tight-firing, which means that they will warp when they are dried and fired. If such ware were fired at very low heats, fairly satisfactory results could be obtained; for the most part, however, the use of ball clay is not satisfactory. Plastic kaolins are also unsuitable because they do not fire hard enough and probably will crack when fired.

Some of the finest clays which are suitable for creative ceramic work are composed essentially of a combination of ball clay, fine-grained silica, and several impurities, particularly iron and titanum in oxidized form, such as are found in the cream, buff, and red-firing clays. There is also a clay that contains a considerable amount of manganese which fires black.

Variations of such clays are to be found in many localities, and with a little refinement by screening out the coarser impurities, a good usable clay is obtained.

(2) Chemical

The physical, chemical, and fired properties of a standard English ball clay and a Georgia china clay are given in Table I.

TABLE I

Raw properties	English ball	Georgia china
Linear dry shrinkage (%)	8.7	4.5
Color	Light gray	Excellent white
Plasticity	Very good	Short
Water of plasticity (%)	36.5	45.48
Modulus (lb./sq. in.)	302	30
Residue (wet test) (%)		
On 100-mesh	0.02	0.01
" 200- "	0.12	0.05
" 300- "	0.28	0.20
Particle size (μ diam. or less)	(%)	(%)
0.5	76.1	17.0
1.0	82.8	33.0
2.0	93.5	41.0
5.0	99.2	61.0
10.0	99.72	80.8
44.0	99.8	99.2
+44.0	0.2	0.8
Fired properties (cone 8)		
Linear firing shrinkage (%)	10.1	5.3
Total shrinkage (%)	16.4	8.0
Absorption (%)	0.0	11.0–20.0
Color	Light gray	Very good white
Chemical analysis	(%)	(%)
Silica	52.2	45.32
Alumina	32.3	39.51
Lime	0.2	0.06
Magnesia	0.4	0.04
Titania	1.31	1.30
Iron oxide	0.7	0.38
Soda	1.10	0.19
Potash	2.45	0.09
Ignition loss	9.7	13.75
pH	5.05	5.01

There is fairly close similarity between the chemical analyses of these two clays, but there is a vast difference in their cross-breaking strength and particle size; there is also a marked divergence in the fired properties as reflected in the shrinkage figures and absorption data at cone 8 (see Table I). Clays of these types are of use to the art potter only in compounding bodies.

(3) Bodies and Blends

There is no limit to the results that may be obtained if there are a number of clays available that will fire red, buff, cream, white, gray, and black. The possibilities of securing unique results from these clays are intriguing to the potter.

Feldspar, talc, plastic Vitrox, barium carbonate, and whiting may be used as fluxes for the body.

Calcined clay, known as grog or chamotte, also offers the art potter an opportunity to do many things. Buff grog, resulting from ground saggers and brick bats, is plentiful, but it is conceivable that pleasing and unique effects could be obtained by making grog of clays that fire to other colors. All that is necessary is to break down the clay in the raw state to the size desired and then to fire it to the heat that will yield a calcine of the desired color. Each clay, of course, is limited as to the color or shades of color that may be secured from it.

The fineness or particle size of calcined clay (grog) must be determined by the type of surface that the worker wants. If the grog is too coarse, the resulting ware will have a very rough surface, whereas calcine that is ground to 80-mesh will yield smooth surfaces, and there will be no noticeable pieces of the calcine showing in the fired ware.

United Clay Mines Corporation
Trenton, New Jersey

CERAMIC HISTORY

EDWARD GOODRICH ACHESON*

In the fall of 1880, a young man, jobless but with a keen interest in electricity, arrived at the laboratory of Thomas A. Edison at Menlo Park. A white lie got him on the pay roll. After a short time in the drafting room, E. G. Acheson was placed in the original experimental department at $7.50 a week. Soon he was in the lamp factory learning all the details in preparation for arranging the exhibit of Edison's electrical inventions at the International Exposition in Paris. After the Exposition, he assisted in constructing machine shops and lamp factories to operate the Edison patents in Europe, and in 1884 he returned to New York only to leave Edison and to try some experimental work on a scheme for "controlling electric currents, regulating dynamos, etc." Finding two backers, he built a "new style of dynamo" which proved to be a failure, for, although it would produce a current of immense amperage, the voltage was absurdly low. "Another failure added to a long list," he said. His next experiment, on an anti-induction telephone wire, was made by taking "a rubber-covered wire, coating it with graphite, passing it through a copper solution, and plating on it a tube of copper; next braiding cotton over the tube; then soaking the cotton with asphaltum; then covering the whole with a lead pipe covering." He patented the process which a short time later he sold to George Westinghouse for $7000 in cash and $50,000 in stock of the Standard Underground Cable Company, which, however, because of a reduction in the Company's capital, was soon reduced to $16,666.

After a three-year term as electrician to the Cable Company at a regular salary, Dr. Acheson conceived the idea that if he could establish a small electric lighting plant in some town, he could make the plant pay its way by night lighting and yet use the dynamo for experiments during the day. Monongahela City was selected as the location. He soon turned his attention to making rubber synthetically and succeeded, in 1891, in producing a small piece. Unfortunately, one of his partners in the lighting enterprise arrived in Monongahela City to see the plant just after investing considerable money in a rubber-tree grove in Mexico, where he intended to produce more rubber than the world would use, and he advised Dr. Acheson to shut the plant up and "throw it into the Monongahela River." Dr. Acheson lost interest in rubber, not even making a record of how he produced his sample; but ignoring the advice, he turned his plant to new uses.

The value of an artificial abrasive had been brought to his attention by a chance remark made in 1880 by George F. Kunz of Tiffany & Company. He decided to try to produce one. The recollection of an experiment which he had once conducted for his brother on the reduction of iron from its ores by the use of natural gas suggested a starting point, for, in this experiment, some clay articles placed in a highly heated furnace into which natural gas was passed had been found, when cold, to be thoroughly impregnated with carbon. The procedure by which Dr. Acheson discovered the material to which he gave the name Carborundum is described in his own words:

> An iron bowl, such as plumbers use for holding their melted solder, was attached to one lead from a dynamo and filled with a mixture of clay and powdered coke; the end of an arc light carbon attached to the other lead was inserted into the mixture. The percentage of coke was high enough to carry a current, and a good strong one was passed through the mixture between the lamp carbon and bowl until the clay in the center was melted and heated to a very high temperature. When cold, the mass was examined. It did not fill my expectations, but I by sheer chance happened to notice a few bright specks on the end of the arc carbon that had been in the mixture.[1]

One of these specks, when mounted on the end of a lead pencil and drawn across a pane of glass, cut it like a diamond. After patient work with a small furnace made of

* From Research, a National Resource. Issued by the National Resources Planning Board and compiled by the National Research Council; 370 pp. For sale by the Superintendent of Documents, Washington, D. C.; price, $1.00.

[1] E. G. Acheson, A Pathfinder: Discovery, Invention, and Industry, pp. 98-99. The Press Scrap Book, New York, 1910.

brick, Dr. Acheson had enough of his material to take to the lapidaries in New York City. It was during the journey that the substance received its name, because of the discoverer's hunch that it was composed of carbon and corundum, a hunch that later proved to be a mistake, for Carborundum is a compound of carbon and silicon. In New York, a diamond cutter bought the tiny supply at forty cents a carat or at the rate of about $750 a pound.

Upon his return from a trip to Europe, where he sold the foreign patent rights, Dr. Acheson heard of the new electrical development at Niagara Falls. After inspection of it, he placed before his directors a plan for building a new plant equipped for a thousand horsepower. To do this, in the face of the fact that the Monongahela plant, using only 134 h.p., was producing twice as much as was being sold, entailed too great a risk for them, and they resigned. But Dr. Acheson went on with his plans, and although he was forced eventually to appeal to some Pittsburgh bankers for assistance, the Niagara Falls works were started in the fall of 1895. By 1910, although Dr. Acheson had lost control of it, the Company was using 10,000 h.p. and producing Carborundum at the rate of 10,000,000 pounds a year. A new industry had been created, the value of the product proved, and a market for it found even though the country had been passing through a financial depression.

But Dr. Acheson's contributions to industry were not over. Under patents secured in 1895, 1896, and 1899, he began the manufacture of graphite. Other experiments followed, and in 1906, while trying to increase the value of Carborundum as an abrasive, he found in the furnace a small amount of "a very soft, unctuous, noncoalescing graphite," which he immediately recognized as an ideal lubricating product. More experiments resulted in a method of suspending graphite in water to form a lubricant called Aquadag. The next step was the transference of the graphite from the water medium to an oil medium to form an improved lubricant called Oildag. Dr. Acheson felt that those two products would probably prove to be of more value to the world than any of those he had previously developed.

GROWTH OF ABRASIVE INDUSTRY*

Realizing that his new abrasive, which is close to the diamond in hardness, would be of inestimable value to industry if it were made into wheels to replace the unsatisfactory emery wheel, Dr. Acheson tried to get the established manufacturers of emery wheels to use it. They came back with the objection that it was impossible to make a successful wheel with the new substance.

Undaunted, Dr. Acheson began to manufacture wheels in his little Monongahela plant and the first Carborundum wheels to be made were the tiny mounted shapes now used largely by dentists. Later, George Westinghouse ordered several thousand wheels for use in grinding joints in his new incandescent electric lamps. Dr. Acheson says in his memoirs that he made up that order with his own hands.

Almost overnight the uses for the new manufactured abrasive multiplied and remultiplied, for the new wheels made from the new abrasive gave the rapid cutting qualities that industry was demanding.

A few years after Dr. Acheson's invention, Charles B. Jacobs discovered a method for making aluminum oxide in the electric furnace. Aluminum oxide is the chief abrasive constituent of natural emery and corundum. It is tougher than silicon carbide, but not so hard or so sharp. Between the two, industry now has abrasives suited to the grinding of all types of metals and many other substances. Although it is still common for workmen to refer to all grinding wheels as "emery" wheels, actually few emery wheels, if any, are used in modern industrial plants.

* From a Carborundum Company press release dated March 1, 1941.

ACTIVITIES OF THE SOCIETY

NEW MEMBERS FOR SEPTEMBER

Corporation

PEARSON, E. J. & J., LTD., C. W. Thomas (voter), Firebrick Works, Stourbridge, England.

Personal

BOEHLER, J. J., 391 Poplar Ave., Elmhurst, Ill.; plant superintendent, Chicago Vitreous Enamel Product Co.

CAREY, J. SHELDON, Teachers College, Columbia Univ., New York, N. Y.; instructor.

FREID, BERNARD, 3067 Brighton 3 St., Brooklyn, New York, N. Y.

GOINS, ROBERT R., 890 Allison Ave., Washington, Pa.; plant chemist, Tygart Valley Glass Co.

*HANNA, HENRY N., Hearst Tower Bldg., Baltimore, Md.; president, Clinchfield Sand & Feldspar Corp.

HOWE, ELROY E., 1173 S. Harvey Ave., Oak Park, Ill.; laboratory assistant, Chicago Vitreous Enamel Product Co.

JONES, EDMUND, JR., 2840 Ewald Circle, Detroit, Mich.; field ceramic engineer, Atlas Lumnite Cement Co.

LOWE, GEORGE K., 1711 Compton Rd., Cleveland Heights, Ohio; sales representative, Charles Taylor Sons Co.

METSCH, C. G., Highland Colony, East Liverpool, Ohio; secretary and treasurer, Potters Mining & Milling Co.

SCHRECKENGOST, VIKTOR, 2366 Noble Rd., Cleveland, Ohio; art director and instructor.

* Indicates former member of The Society rejoining.

(1941)

MEMBERSHIP WORKERS' RECORD

Corporation

Office 1

Personal

A. A. Ayars	1	R. W. Knauft	1
R. E. Birch	2	V. H. Remington	1
R. L. Fellows	1	H. E. Riegger	1
M. E. Holmes	1	B. T. Sweely	1

Office 1

Grand Total **11**

MEMBERSHIP ROSTER OF THE AMERICAN CERAMIC SOCIETY

The Roster of paid members is being published for the use of the members of The Society. The list is alphabetical; Corporation Members are in black-face type, the name of the voting representative following in parentheses; Fellows are preceded by *; Institute of Ceramic Engineers are preceded by †; Charter Life, Life, Honorary, and Student Members are indicated after their respective names.

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Abbott, Gordon H., 53 Norman Rd., Greenwich, London, England
Abingdon Sanitary Mfg. Co. (R. E. Bidwell), Abingdon, Ill.
Abramson, Isaac, Klabin Irmaos and Cia., Rua Buenos Ayres 4, Rio de Janeiro, Brazil
Ackerson, C. H., Washington Porcelain Co., Willow St., Washington, N. J.
A C Spark Plug Co. (T. G. McDougal), Flint, Mich.
Adams, Frederick W., 1271 Beechwood Blvd., Pittsburgh, Pa.
Adams, Leason H., 2801 Upton St., Washington, D. C.
Adamston Flat Glass Co., Box 631, Clarksburg, W. Va.
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Ball, G. A., Ball Brothers Co., Muncie, Ind.
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Paid Membership Record

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1940	1995	260	25	574	220	3074
January 20, 1941	2007	262	27	594	220	3110
March 10, 1941	2023	257	26	620	220	3146
April 21, 1941	1794	247	47	563	220	2871
May 21, 1941	1839	249	47	580	220	2935
June 21, 1941	1875	249	45	584	220	2973
July 21, 1941	1898	251	46	587	220	3002
August 21, 1941	1935	253	45	590	220	3043
September 21, 1941	1963	254	43	592	220	3072

All dues are deductible under provisions of Federal Income Tax Law.

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(1) pay one-fourth of the annual fee or $3.13 and receive only the October, November, and December publications or

(2) pay the full $12.50 for 1941 membership and receive all of the 1941 publications or

(3) pay $12.50 and join as of 1942 and receive the December, 1941, issues (which include the indexes) as a bonus.

The Design of Refractory Shapes as a Means to Improve Efficiency

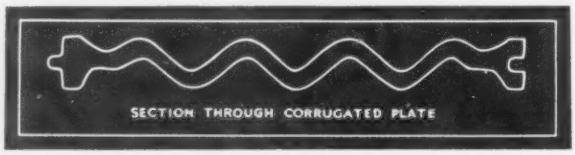
A VAST amount of work has been done and much published literature exists with regard to the composition—both chemical and physical—of refractory mixtures or bodies. However, composition alone does not provide all the answers to vexing problems connected with satisfactory refractory service.

While design of refractory shapes has had much attention, this important factor has frequently been overlooked. This has sometimes resulted in designing refractory shapes to fit the furnace construction, whereas greater efficiency would have been possible had the furnace been constructed around suitably designed refractories.

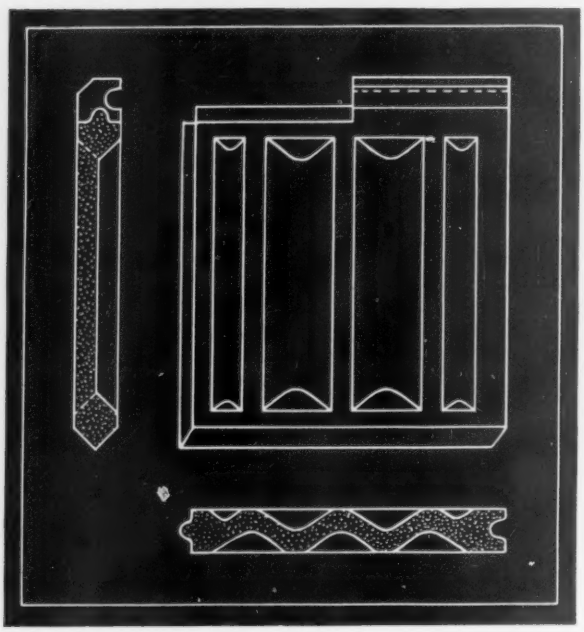
Improved design of refractories has proven, over a number of years, to have been of definite service and economy to users of enameling furnaces.

For example, enameling furnaces are operated in oxidizing atmospheres and little or no water vapor can be tolerated in the chamber where the product is being heated.

The most successful manner of attaining these conditions is to protect the ware from the products of combustion which come from gas, oil and coal fuels, by the use of refractory tiles called "muffle plates." This, however, brings in another important factor—the degree of heat transfer of these muffle plates and consequent effect on fuel costs, since the heat is dissipated into the ware indirectly through these plates.



NORTON CORRUGATED PLATE FOR CERAMIC KILN



NORTON CORRUGATED PLATE FOR MANION V-BOTTOM ENAMELING FURNACE

The heat conductivity of the muffle material, the thickness of the refractory and the available surface radiation area, all exert control on the number of heat units passing from the ignited gases on one side of the tile to the ware on the other side.

Assuming the heat conductivity of the material as constant, there are still two important variables which directly affect the furnace efficiency.

The first variable is the thickness of the muffle plate. To prevent distortion, especially in the heating and cooling cycles, or when a furnace is loaded with large amounts of cold ware—mechanical strength of the plates requires design with sufficient cross-section or thickness.

The simple invention of the corrugated muffle plate simultaneously accomplished two desirables. It enabled thinner cross-section to be utilized without decreasing mechanical strength, at the same time presenting 50 % additional exposed plate area for dissipation of heat to the ware.

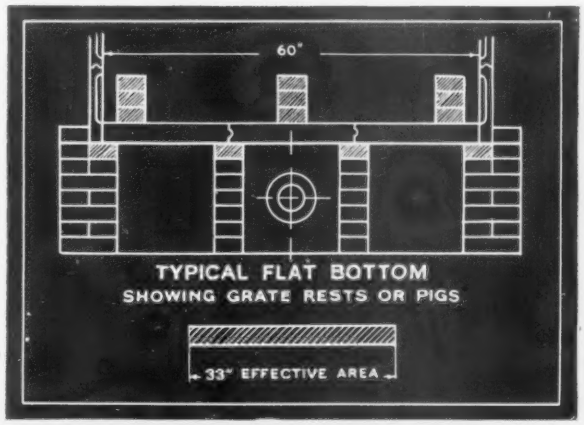
Horizontal hearth plates have presented problems to furnace operators in the past and still do. Plate thicknesses vary in proportion to the unsupported span. Just as was done through designing corrugated muffle plates—so in furnace bottoms, two desirable results were obtained through a single invention, the so-called V-bottom. The tile being at a 45 degree angle required 46 % less cross-section thickness for equal strength. Furnace efficiency immediately increased and when these bottom V plates were further decreased 50 % in thickness by virtue of corrugation with the same strength, furnace efficiencies were *again* doubled.

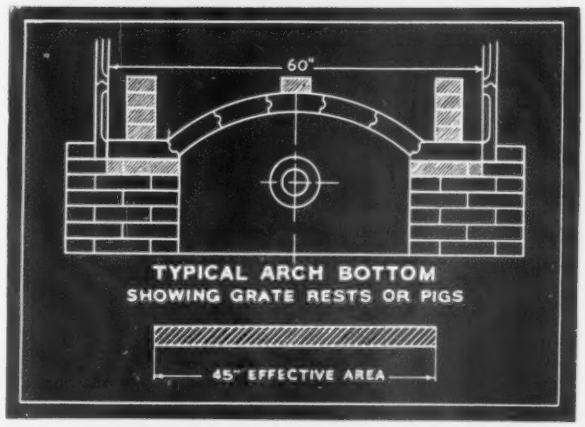
High-speed batch type enameling furnaces have muffle plates in the sidewalls, arch and bottom, in order to present the maximum amount of radiation area.

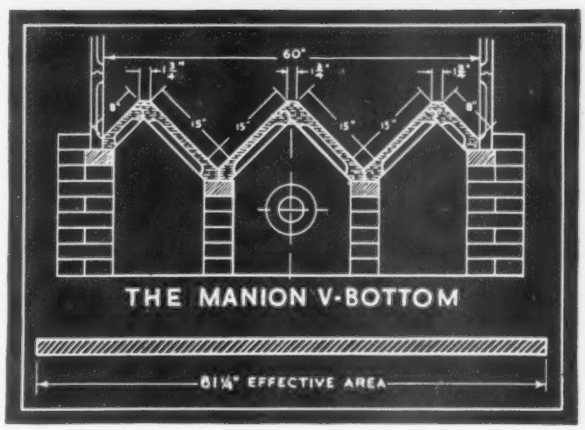
Straight-through continuous furnaces have muffle plates on both sidewalls and bottom, through the entire length of the high-heat or fusion zone.

U type furnaces have muffle plates on both sidewalls and the bottom. The most recent installations have incorporated the use of a center wall muffle, thereby increasing the muffle area 30 % over the earlier models.

These examples are clear evidence that much may be accomplished by proper design. Actually in enameling furnaces improved design of refractories has resulted in more muffle area within the high-heat zone and this in turn has resulted in increased overall efficiency.







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Thomas, James A., Iroquois China Co., Syracuse, N. Y.
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Thompson, M. W., Hall China Co., East Liverpool, Ohio
Thompson, Noel M., 721 Shady Lane, Sta. 16, Pittsburgh, Pa.
Thompson, Thomas C., 1419 Central Ave., Wilmette, Ill.
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Toyo Toki Kaisha, Ltd. (Shigeki Morimura), Kokura, Japan
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†Tredennick, William T., 5428 Woodbine Ave., Philadelphia, Pa.
*†Treischel, C. C., R. T. Vanderbilt Co., 230 Park Ave., New York, N. Y.
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Turner, W. E. S. (Honorary), "Elmfield," Northumberland Rd., Sheffield, 10, England
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Tuttle, Milton (Student), Almond, N. Y.
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Ulrich, Robert J., 1013 E. St. Catherine St., Louisville, Ky.
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United Glass Bottle Mfgrs., Ltd. (T. C. Moorshead), 8 Leicester St., London, W. C. 2, England
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Universal Clay Products Co. (C. A. Bloor), Sandusky, Ohio
Universal Dental Co. (Joseph Kohn), 48th & Brown Sts., Philadelphia, Pa.
Universal Sanitary Mfg. Co. (W. Keith McAfee), New Castle, Pa.
Utecht, Norman R., Olean Glass Co., Olean, N. Y.
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Valentine, Frank R., Toms River, N. J.
†Vance, Edward D., Bay State Abrasive Products of Canada, Ltd., Brantford, Ontario, Canada
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Vanderbilt, R. T., Co. (Ira E. Sproat), 230 Park Ave., New York, N. Y.
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Van Gelderen, F. M., Enschede, Holland
Van Houten, Robert M., 619 S. Armstrong St., Kokomo, Ind.
Vanick, James S., International Nickel Co., Inc., 67 Wall St., New York, N. Y.
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Victor Insulators, Inc. (P. W. Price), Victor, N. Y.
Vielhaber, Louis, Lippestr. 11, Duisburg, Germany
Vieweg, Hermann, 323 Lawrence Ave., Highland Park, N. J.
Vincent, George L., 56 Jefferson Ave., Rockville Center, N. Y.
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Vitreous Steel Products Co. (Edgar H. Weil), Sta. D, Cleveland, Ohio
Vitro Mfg. Co. (E. M. Fleck), Corliss Sta., Pittsburgh, Pa.
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Walker, Prescott H., Carborundum Co., Niagara Falls, N. Y.
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Walsh, Donald E., Consolidated Feldspar Corp., East Liverpool, Ohio
Walsh, N. S. C., 4070 N. Main St., St. Louis, Mo.
Waltham Grinding Wheel Co. (Robert L. Lyons), Waltham, Mass.
*†Walton, S. F., Exolon Co., Blasdell, N. Y.
Walworth, Chester A., Libbey-Owens-Ford Glass Co., Charleston, W. Va.
Wampler, Roy W., Libbey-Owens-Ford Glass Co., Oakdale & E. Broadway, Toledo, Ohio
Wang, Harold E. M., Yao Hua Mechanical Glass Co., Chinwangtao, Hopei Province, North China
Ward, Charles J., A. P. Green Fire Brick Co., Ltd., Leaside, Ontario, Canada
Ward, George V., 192 Kimberly Ave., New Haven, Conn.
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Wells, Joseph, Homer Laughlin China Co., Newell, W. Va.
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West, Frank, Haslemere Greenlane, Buxton, Derbyshire, England
West, Howard F., 922 Washington St., Lockport, Ill.
Western Brick Co. (F. M. Butterworth), Danville, Ill.
Western Electric Co. (L. I. Shaw), Hawthorne Sta., Chicago, Ill.
Westinghouse Electric & Mfg. Co. (E. H. Fritz), Derry, Pa.
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Wheeler, Thorne L., Arthur D. Little, Inc., 30 Charles River Rd., Cambridge, Mass.
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Whitaker, H., Rustless Iron Co., Ltd., Trico Works, Keighley, England
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Whitely, Joseph O., Dentists' Supply Co., York, Pa.
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Winemiller, William F., 6219 N. Sheridan Rd., Chicago, Ill.
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Zeiller, Irwin F., B. F. Drakenfeld & Co., Inc., 45–47 Park Place, New York, N. Y.
Zeiller, Oscar F., 42–38 204th St., Bayside, L. I., N. Y.
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†Zimmer, David C., Patterson Refractories Co., East Liverpool, Ohio
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REPORT OF SPECIAL COMMITTEE ON MEMBERSHIP CLASSES

This Committee was charged with the duty of investigating membership classes with the specific purpose of studying the possibilities of offering a lower annual rate of dues to persons who want to be members of The Society but who do not want the publications because they have access to them through other sources.

Cost data show that if a small group of members wanted to retain their membership but did not want to receive *The Journal* and *The Bulletin*, we could save approximately $2.50 on each such member. Alternatively, if a special rate were created for new members who have the above preference, we could not, out of fairness to present membership, offer a saving of any more than $2.50.

Therefore, if such a membership class were created, the dues could not be lowered from the present $12.50 annual rate to an amount any less than $10.00 per year.

We have realized that certain persons do not join The Society because there seems too little inducement to pay the membership fee when they already have full access to the publications. If a rate giving substantial savings is offered such members, the Committee feels that a considerable number of present members would change their status to the less expensive class. The opportunity to obtain Society membership at $10.00 would be more likely to appeal to persons now paying $12.50 than to those now paying nothing. Dues in The Society are already very low, and cutting rates probably would have little effect on increasing membership.

A study of twenty-one technical societies shows that the average dues are about $14.00, and besides that, eleven out of the twenty-one charge an entrance fee about equal to the annual dues.

Attempts to obtain new members generally give the impression that it is the publications of The Society that appeal most to prospective members rather than the other activities.

Accordingly, our first conclusion is, if we made such a class, that making a special rate of $10.00 would not be likely to increase the membership substantially.

Furthermore, the Committee feels that *The Bulletin* is the life blood of The Society for two reasons: (1) all of our advertising revenue comes from it, and (2) it is the mouthpiece between The Society and its members. It would be foolhardy to set up a type of membership which would result in a member not receiving *The Bulletin*. Advertising rates are governed by circulation, so we should do everything to increase circulation of *The Bulletin* rather than decrease it.

Therefore, if we should take the position that every member should at least receive *The Bulletin* (as the American Chemical Society requires in the case of the *News Edition*), then the amount of the saving would be cut about in half, and the best we could offer would be a reduction in rate from $12.50 to $11.25 per year. Such a reduction is too small to accomplish anything but annoyance to the office and is more likely to create problems rather than to improve the position of The Society.

In view of all of the foregoing, the Special Committee on Membership Classes recommends no change in the annual membership rates.

Respectfully submitted: J. D. SULLIVAN,
R. E. BIRCH, and D. E. SHARP, *Chairman*

EDWARD ORTON, JR., FELLOW LECTURERS, 1933–1941

February 14, 1933, Pittsburgh, Pa.
EDWARD W. WASHBURN, National Bureau of Standards, Washington, D. C.; "Phase Rule in Ceramics."

February 13, 1934, Cincinnati, Ohio
ARTHUR L. DAY, Geophysical Laboratory, Carnegie Institution of Washington, Washington, D. C.; "Natural and Artificial Ceramic Products"; published in *Bull. Amer. Ceram. Soc.*, **13** [4] 85–95 (1934).

February 19, 1935, Buffalo, N. Y.
HEINRICH RIES, Dept. of Geology, Cornell Univ., Ithaca, N. Y.; "Geology and Clay Research"; published in *Bull. Amer. Ceram. Soc.*, **14** [9] 279–90 (1935).

March 31, 1936, Columbus, Ohio
WILLIAM J. MCCAUGHEY, Dept. of Mineralogy, Ohio State Univ., Columbus, Ohio; "Contribution of Mineralogy to Ceramic Technology and Research"; published in *Jour. Amer. Ceram. Soc.*, **20** [2] 31–42 (1937).

March 23, 1937, New York, N. Y.
ROBERT B. SOSMAN, Research Lab., U. S. Steel Corp., Kearny, N. J.; "Pyrometry and the Steelmaker's Refractories"; published in *Jour. Amer. Ceram. Soc.*, **21** [2] 37–49 (1938).

March 30, 1938, New Orleans, La.
PAUL F. KERR, Columbia Univ., New York, N. Y.; "A Decade of Research on the Nature of Clay"; published in *Jour. Amer. Ceram. Soc.*, **21** [8] 267–86 (1938).

April 16, 1939, Chicago, Ill.
LAWRENCE E. BARRINGER, General Electric Co., Schenectady, N. Y.; "A Background for Ceramics"; published in *Bull. Amer. Ceram. Soc.*, **18** [8] 275–85 (1939).

April 7, 1940, Toronto, Canada
WOLSEY G. WORCESTER, Dept. of Ceramic Engineering, Univ. of Saskatchewan, Saskatoon, Saskatchewan, Canada; "Orton, the Ceramist."

March 31, 1941, Baltimore, Md.
ERNST A. HAUSER, Dept. of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.; "Colloid Chemistry in Ceramics"; published in *Jour. Amer. Ceram. Soc.*, **24** [6] 179–89 (1941).

PLAQUE TO COMMEMORATE FIRST COLLEGE TRAINING IN CERAMIC ENGINEERING

A plaque commemorating the first collegiate course in ceramic engineering was unveiled with appropriate ceremonies at the Ohio State University, Columbus, Ohio, on September 27.

The plaque was placed on a wall of Orton Hall, adjacent to the classroom where, in 1894, Edward Orton, Jr., held the first collegiate classes in ceramic engineering. Ohio State University is generally recognized as the first college or university in the world to teach ceramic engineering, although some instruction of the trade-school variety had been previously offered in Germany.

Money for the plaque was appropriated by the Fellows of The American Ceramic Society, and R. B. Sosman, Dean of Fellows, presided at the ceremonies. Dr. Sosman is assistant director of the research laboratories of the U. S. Steel Corporation at Kearny, N. J. He took the place of the President of The Society, Jesse T. Littleton, assistant director of research at the Corning Glass Works, Corning, N. Y., who was unable to attend because of injuries recently received in an automobile accident.

Ross C. Purdy, General Secretary of The Society, presented the plaque to the University, and Howard L. Bevis, president of the University, made the speech of acceptance. Arthur S. Watts spoke for the Department of Ceramic Engineering, of which he is Head.

The original design for the plaque was made by James R. Hopkins of the Fine Arts Department at Ohio State University, and it was executed by Paul Bogatay of the ceramic division of that Department. The plaque was fired by the Maurice A. Knight Co., Akron, Ohio.

GLASS DIVISION AUTUMN MEETING

The autumn meeting of the Glass Division was held on September 12 and 13 at the Hotel Conneaut, Conneaut Lake Park, Pa.

The following program was presented:

Friday Session

(1) Report of Committee on Nomenclature and discussion of definition of glass (in charge of F. C. Flint, Hazel-Atlas Glass Co., Washington, Pa.).

(2) Report of the A.S.T.M. committee work on standards (in charge of Louis Navias, General Electric Co., Schenectady, N. Y.).

(3) Report of Committee on Light Protective Glasses for Pharmaceutical Work (in charge of F. C. Flint).

(4) "Sterilamps" by ALFRED PAULUS, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Saturday Session

(1) "Water Hammer Breakage in Glass Containers" by T. C. BAKER, Hartford-Empire Co., Hartford, Conn.

(2) "Selenium Ruby Glass" by JOHN D. SULLIVAN and CHESTER R. AUSTIN, Battelle Memorial Institute, Columbus, Ohio.

(3) "Chemical Mechanism of Decolorizing Glass with Selenium" by FRANK DAY, JR., and ALEXANDER SILVERMAN, University of Pittsburgh, Pittsburgh, Pa.

(4) "Alumina-Silica Relationship in Glass" by HURD W. SAFFORD and ALEXANDER SILVERMAN, University of Pittsburgh, Pittsburgh, Pa.

S. R. Scholes, New York State College of Ceramics, Alfred, N. Y., was in charge of the golf tournament, dinner, and card party which provided the entertainment for Saturday afternoon and evening.

O. HOMMEL MEMORIAL TROPHIES

In memory of its late president and founder, Oscar Hommel, the O. Hommel Company awarded two bronze plaque golf trophies to the outstanding golfer at the autumn meeting of the White Wares and Materials and Equipment Divisions held on September 19 and 20 at the Summit Hotel, Uniontown, Pa., and to the best golfer at the Glass Division autumn meeting held on September 12 and 13 at Conneaut Lake Park, Pa.

Winners of the awards were as follows: Glass Division: C. C. Treischel, R. T. Vanderbilt Co., New York, N. Y.; White Wares and Materials and Equipment Divisions:

W. M. Weathers, Anaconda Copper Mining Co., Akron, Ohio.

The O. Hommel Company plans to make these awards an annual event. Two new trophies will be awarded each year, with the names of the winners engraved on the bronze plaques.

O. Hommel Memorial Trophy

CERAMIC ART AT BLUE RIDGE

The old mountain craft of pottery making proved to be an entertaining vacation pastime for visitors to Blue Ridge, N. C., this summer. Tourists gained as much pleasure from the ceramic art workshop as they did from the mountains and cool climate of this summer vacation section.

Kenneth E. Smith, head of the Department of Ceramics at Sophie Newcomb College, New Orleans, La., and chairman of the Art Division of The American Ceramic Society, for the second consecutive summer taught a course in the various processes of making pottery and other forms of ceramic art.

Kenneth E. Smith throwing a bowl on a potter's kick wheel.

His class was run on a workshop basis, with students learning by doing rather than by listening to lectures. They tried their hand at throwing on the potter's wheel, casting, hand building by the coil method, sculpture, baking the biscuit, and glazing.

The shop is completely equipped with twirlers, kick wheels, hog kiln, electric kiln, and tools for sculpture. Among the articles made by visitors were bowls, vases, pitchers, ornamental buttons and pins, sculptures, plaques, and tile.

Students learned the different types of clays, slips, and glazes and what could be made with each. Special attention was paid to local Southern clays and their commercial possibilities.

The class included people from all parts of the country, young and old, amateur and professional, and each found something to make within the range of his ability.

James Harris handing pottery out of the mouth of the hog kiln to Frances Stewart.

Kenneth E. Smith, Mable McAliley, and Frances Stewart examining some of their finished ware.

Several of them, who are art teachers in the winter time, attended the class to get further training.

A feature of the program each summer is the meeting of the Southern Art Institute, at which time all types of artists from various parts of the country gather to exhibit their work and to confer about art. At this time, many prominent potters display examples of their work.

The Art Division of The American Ceramic Society has held its autumn meeting at Blue Ridge for three years. Members of the ceramic class were able to hear talks by outstanding members in the field and to make tours of some of the leading mountain potteries.

NECROLOGY

DURWOOD B. WALTERS

Durwood B. Walters, vice-president and general manager of the Chicago Vitreous Enamel Product Co., Cicero, Ill., died on August 18 at the Evanston Hospital, Evanston, Ill. He was forty-eight years old and had been in failing health for the past several months.

Durwood B. Walters

Mr. Walters had been associated with the porcelain enameling industry throughout the past thirty-two years, having started work with the Lisk Manufacturing Company at Canandaigua, N. Y., at the age of sixteen years. He was later associated with the old Bellevue Porcelain Company, Detroit, Mich., where he served as foreman, and with the Cribben & Sexton Co., Chicago, Ill., where he held the position of superintendent of enameling operations.

In 1921, Mr. Walters joined the Chicago Vitreous Enamel Product Company as assistant foreman and progressed through the positions of service man, superintendent, salesman, and sales manager until he was appointed vice-president in charge of sales and service in 1930. He was made vice-president and general manager in 1934.

Born at Urbana, N. Y., February 4, 1893, Mr. Walters was the son of Grant and Dora B. Walters.

Mr. Walters had been a member of The American Ceramic Society since 1923.

FREDERICK SALT

Excerpts from the necrology notice appearing in the July, 1941, issue of the *Refractories Journal:*

We regret to record the death of Frederick Salt, for over twenty years a prominent official of the British Ceramic Society, which took place on June 15, 1941, at the North Staffordshire Royal Infirmary.

Mr. Salt, who was fifty-one years old at the time of his death, had been in failing health for about two months. He was unmarried and resided at Basford.

His work for the British Ceramic Society occupied most of his time. He held the office of assistant secretary of the Society, and he had carried out most of the secretarial duties since the death of Dr. Mellor, who was secretary for many years and with whom he was closely associated. As assistant secretary, he had for some time been responsible for compiling the *Transactions of the British Ceramic Society* and for carrying out the editorial work. He was an accomplished linguist and also dealt with the abstracts from foreign technical papers for the Society. He had spent several years in Germany and was interned in that country when hostilities in the last war began.

Mr. Salt also edited the confidential publications of the British Refractories Research Association.

For several years, Mr. Salt taught German at the evening classes of the North Staffordshire Technical College and the City School of Commerce.

C. H. MITCHELL

Brigadier-General Charles H. Mitchell, an honorary life member of the Canadian Ceramic Society and Dean of the Faculty of Applied Science and Engineering at the University of Toronto for more than twenty years, died on August 26 at the Toronto General Hospital. He was in his seventieth year and had been ill for several months. He was retired as Dean in June.

General Mitchell

Since September, 1939, General Mitchell had been doing special war work under the Department of National Defense. He was widely known and respected, not only as an engineer, but as a soldier. He had a distinguished war record, and his decorations included the D.S.O., Companion of the Order of St. Michael and St. George, Companion of the Order of the Bath, Officer of the Legion of Honor (France), Officer of the Order of Leopold (Belgium), and Officer of the Order of the Crown of Italy. His civilian honors included the Doctor of Laws (honorary) and Doctor of Engineering.

General Mitchell was born sixty-nine years ago in a Methodist parsonage in Petrolia, the son of the late Reverend George Mitchell. He was graduated from the University of Toronto in 1892 with the degree of B.A.Sc.; he received his C.E. there in 1898. From 1894 to 1900, he served as city engineer of Niagara Falls and was also in private practice as a hydro engineer. For the next five years, he was assistant engineer of the Ontario Power Company, and in 1906, he traveled in Europe where he studied hydroelectric power developments.

Before his appointment to the University in 1919, General Mitchell was a consulting engineer in Toronto for many years with his brother, Percival H. Mitchell. He served on various civic boards, and, in 1913, he was elected a member of the University Board of Governors.

In 1920, while Dean of Engineering, he was appointed a royal commissioner to report on radial railways and was made arbitrator as to power shortage at Niagara Falls and the setting of power rates. For many years, he served on the Joint Board of Engineers (Canada and the United States) to study and report on the St. Lawrence waterway navigation and power projects.

He occupied many prominent positions in the public life of Toronto and had long been an active member of the Toronto Board of Trade, of which he was twice elected president. He was a member of the Institution of Civil Engineers (London), a former president of the Engineering Institute of Canada, and a former president of the Association of Professional Engineers of Ontario. In 1930, he was the recipient of the Gold Medal of the American Society of Mechanical Engineers. His hobby was ceramics, and he had a splendid collection gathered from all over the world.

General Mitchell had been a president of the National Club, and he was a member of the Arts and Letters Club and the Military Institute. He also belonged to the Athenaeum in London, England.

ALANSON BIGELOW HOUGHTON

Alanson Bigelow Houghton, former ambassador to Germany and Great Britain and a leader in the glass industry in the United States, died at South Dartmouth, Mass., on September 16, 1941. He was seventy-seven years old.

Following an education at Harvard University, with supplementary studies in Paris and Berlin, Mr. Houghton grew up in the glass business in which his grandfather and father had pioneered. He was responsible for scientific advances in the Corning Glass Works where he served successively from 1889, becoming second vice-president in 1903, president in 1910, and subsequently occupying the positions of chairman of the board and chairman of the executive committee.

Mr. Houghton was formerly a director of the Metropolitan Life Insurance Company and president of the Board of Education of Corning, N. Y. He was twice a presidential elector and was a member of the Sixty-Sixth and Sixty-Seventh Congresses from the Thirty-Seventh District of New York. He resigned from Congress to become ambassador extraordinary and minister plenipotentiary to Germany in February, 1922. He resigned from this post in 1925 and was thereafter appointed ambassador to Great Britain.

He was also chairman of the Institute for Advanced Study at Princeton University and was treasurer of the Carnegie Endowment for International Peace.

Mr. Houghton was a man whose experience encompassed both the business of manufacture and the business of politics. He was a man who, to Europeans, interestingly represented America at its best. His career in the glass industry was outstanding. His son, Amory Houghton, is at present chairman of the board of Corning Glass Works.

THE AMERICAN CERAMIC SOCIETY

FOR CONTINUING EDUCATION
IN CERAMICS

NOTES AND NEWS

CERAMIC ASSOCIATION OF NEW YORK

The annual meeting of the Ceramic Association of New York will be held on Friday, October 17, 1941, at the New York State College of Ceramics, Alfred, N. Y. The program will consist of (1) reports on the research work of the Ceramic Experiment Station for the past year and (2) a question forum on ceramic engineering.

UNIVERSITY OF ILLINOIS CONFERENCE ON GLASS PROBLEMS

Plans are being made for the Sixth Conference on Glass Problems to be held under the joint auspices of the Department of Ceramic Engineering, the University of Illinois, Urbana, Ill., and the Chicago Section of The American Ceramic Society. The Conference will be held at the University on Friday and Saturday, November 14 and 15 (not on November 7 and 8, as previously announced).

TENTH ANNUAL NATIONAL CERAMIC EXHIBITION

Syracuse Museum of Fine Arts
October 18–November 16, 1941

The ceramic ware which has been assembled for the Western Hemisphere Exhibition opening at the Syracuse Museum of Fine Arts in celebration of the tenth anniversary of the National Ceramic Exhibition will be shown in an effective setting designed especially for the event by Bill Atkinson, a Syracuse designer. This special installation was made possible by Thomas J. Watson, president of the International Business Machines Corporation, which is a joint sponsor with the Museum of this first exhibition of contemporary ceramics of the Western Hemisphere.

For the first time at a national exhibition, ceramic ware will be shown in contemporary interiors to demonstrate the suitability of present-day ceramics. Part of the gallery will be transformed into two rooms. In one room, authentic period furniture and decorations will be used; the other room will have a modern scheme, with furniture and decorations designed and executed especially for this Exhibition.

Miss Anna W. Olmsted, director of the Syracuse Museum of Fine Arts, has selected the Canadian pottery for the Exhibition from a large collection assembled by the Canadian Potters' Guild for the annual Toronto Exposition in Toronto, Canada. The pottery will be purchased by Mr. Watson and will go to his own collection after its showing in Syracuse and on the winter circuit.

Miss Marinobel Smith, art director for the International Business Machines Corporation, has collected the South American pottery and ceramic sculpture for the Exhibition, all of which will be purchased by Mr. Watson.

Argentine painters and sculptors are now turning to the ceramic medium and are producing sculpture and mural decorations; in Brazil, however, artists are more interested in beautiful pottery with a utilitarian value.

Neither the Canadian nor the South American ceramic ware will be subject to the jury.

Members of the national jury who will judge the entries from the United States are *Chairman*, Richard F. Bach, director, industrial relations, Metropolitan Museum of Art; Henry Varnum Poor, painter and ceramist, New York; Waylande Gregory, sculptor, New York; Reginald H. Poland, director, Fine Arts Gallery, San Diego, Calif.; and Frederick H. Rhead, art director, Homer Laughlin China Co., Newell, W. Va.

Winter Circuit

At the close of the initial showing in Syracuse on November 16 (the date has been extended from the previously

announced date of November 12), a selected group from the Western Hemisphere show will be sent on circuit to the following galleries: New York, W. & J. Sloane Co., December 8–24, 1941; Chicago Art Institute, January 20–February 23, 1942; Washington, D. C., Corcoran Art Gallery, March 4–25, 1942; Cincinnati Art Museum, April 3–26, 1942 (booking arranged to coincide with the Forty-Fourth Annual Meeting of The American Ceramic Society); and Philadelphia Art Alliance, May 6–27, 1942. (Other bookings are pending.)

CARBORUNDUM COMPANY EXHIBIT
Chicago Museum of Science and Industry

An educational exhibit which tells the story of modern manufactured abrasives has been installed at the Chicago Museum of Science and Industry by the Carborundum Company, Niagara Falls, N. Y.

Dedication ceremonies will be held on Thursday, October 16, beginning with a reception at the Hotel Windermere, near the Museum, where the guests will be received by Frank J. Tone, president of the Carborundum Company; Charles Knupfer and Henry P. Kirchner, vice-presidents; Arthur Batts, secretary; F. H. Manley, treasurer; and F. J. Tone, Jr., and E. R. Newcomb, sales managers. After the reception, guests will go to the Museum for a preview of the exhibit.

This contribution by the Carborundum Company will add another interesting page to the magnificent educational story that is being told to over a million people a year by the Chicago Museum of Science and Industry, the most outstanding institution of its type in the world.

A striking feature of the exhibit is the reproduction of the laboratory where the late Edward Goodrich Acheson created the first man-made abrasive silicon carbide, to which he gave the name Carborundum. (For story of Dr. Acheson, see pp. 342–43, this issue.) The old laboratory, originally located at Monongahela City, Pa., will be reproduced in every historic detail. There will be a replica of the old work table and the iron bowl (such as is used by plumbers for the melting of solder) in which Dr. Acheson created the first few crystals of an abrasive destined to revolutionize grinding. Bending over the bowl is a life-size figure of Dr. Acheson, just as he stood when he made his momentous discovery.

The detailed processes involved in creating the two abrasives, Carborundum-brand silicon carbide and Aloxite-brand aluminum oxide, are portrayed in a series of diaramas showing exact models of the electric furnaces in which these abrasives are produced. The crushing and grading of the crude abrasives, the making of grinding wheels, in fact, all of the major operations necessary in producing modern abrasive products are also shown in diarama. Each scene is interesting and dramatic and is an exact duplicate of each of the original departments in the plant of the Carborundum Company. Above each diarama are photomurals taken in the plant which show the actual scenes from which the diaramas were made.

In one corner of the exhibit is a demonstration booth where simple grinding and sanding machines will be in operation to give visitors some idea of the service of abrasives to industry. Photomurals showing many and varied grinding operations in all types of industrial plants are framed on the walls of the demonstration room, thus supplementing the story told by these machines and emphasizing the great scope of the uses for abrasive products.

Visitors will have the opportunity of hearing and seeing a short version of a sound film showing Dr. Acheson re-enacting his first experiment and also giving them an intimate trip through the Carborundum plant showing the electric furnaces in actual operation and many other scenes depicting the manufacture of abrasives and abrasive products.

Knowledge Is Acquired By Communication

EXPOSITION OF CHEMICAL INDUSTRIES

The Eighteenth Exposition of Chemical Industries will be held at the Grand Central Palace, New York, N. Y., December 1–6, 1941. The display at the Exposition will be the largest to be shown in twelve years; practically all of the available space was allotted more than a month ago.

The plans of the exhibitors reflect the important task which industrial and engineering chemistry has assumed in the present war. Its achievements already have broken many shackles which formerly bound American manufacturers to the use of imported raw materials and manufactured products and have superseded processes formerly under alien control.

GEOLOGICAL RESEARCHES ON CLAY

V. T. Allen, St. Louis University, St. Louis, Mo., has been granted $450 from the Penrose Fund of the Geological Society of America with which to collect clays from selected localities extending from Georgia to New Jersey and to study them by petrofabric, X-ray, and chemical methods, with special reference to the formation of diaspore, bauxite, and "hydromica" by processes of weathering.

As part of the Fiftieth Anniversary of the University of Chicago, September 25 and 26, there was a joint meeting of representatives of the Geological Society of America, Section E of the American Association for the Advancement of Science, and the University. The theme of the meeting was "Frontiers of Knowledge in the Geologic Sciences." One of the topics was "Frontier Researches on the Structure, Properties, and Occurrence of Clay Materials and Their Practical Application," which was discussed under the leadership of Ralph E. Grim, petrographer of the Illinois Geological Survey (for entire program, see the June, 1941, *Bulletin*, p. 228).

—R. B. S.

UNIVERSITY OF PITTSBURGH

Frank Day, Jr., and Hurd W. Safford have received Ph.D. degrees at the University of Pittsburgh, Pittsburgh, Pa., where they majored in glass under the direction of Alexander Silverman. Dr. Day will join the research staff of Corning Glass Works, Corning, N. Y., and Dr. Safford has been appointed an instructor in the Department of Chemistry of the University of Pittsburgh.

DATES TO BE REMEMBERED

1. **Tenth Annual National Ceramic Exhibition, Syracuse Museum of Fine Arts, Syracuse, N. Y., October 18 through November 16, 1941.**
2. **Forty-First Annual Exhibition, New York Society of Ceramic Arts, Barbizon Plaza Art Galleries, Barbizon Plaza Hotel, New York, N. Y., October 27 through November 20, 1941.**
3. **Institute of Ceramic Engineers with Industrial Division, A.I.M.M.E., Rolla, Mo., October 23–25, 1941.**
4. **Structural Clay Products Institute, Hotel Mayflower, Washington, D. C., November 4–6, 1941.**
5. **Ohio Ceramic Industries Association, Ohio State University, Columbus, Ohio, October 24 and 25, 1941.**

CENTRAL DISTRICT ENAMELERS' CLUB

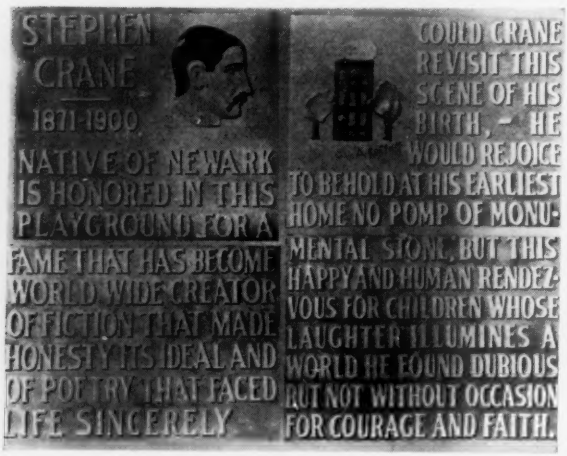
One hundred and five persons attended the annual clambake given by the Central District Enamelers' Club at the Aurora Country Club, Aurora, Ohio, on September 13.

Golf matches and ball games were features of the day and prizes were awarded to the winning teams.

—J. T. IRWIN, *Secretary*

CERAMIC PLAQUES FOR STEPHEN CRANE MEMORIAL

The Stephen Crane Memorial at Newark, N. J., has received thirty-four ceramic plaques dealing with the writings and characters created by the Newark author and poet. The enameled tile were made on the WPA Arts and Crafts Project at Perth Amboy and are the contribution of WPA to the Memorial.


STEPHEN CRANE
1871-1900
NATIVE OF NEWARK IS HONORED IN THIS PLAYGROUND FOR A FAME THAT HAS BECOME WORLD WIDE CREATOR OF FICTION THAT MADE HONESTY ITS IDEAL AND OF POETRY THAT FACED LIFE SINCERELY
COULD CRANE REVISIT THIS SCENE OF HIS BIRTH, - HE WOULD REJOICE TO BEHOLD AT HIS EARLIEST HOME NO POMP OF MONUMENTAL STONE, BUT THIS HAPPY AND HUMAN RENDEZVOUS FOR CHILDREN WHOSE LAUGHTER ILLUMINES A WORLD HE FOUND DUBIOUS BUT NOT WITHOUT OCCASION FOR COURAGE AND FAITH.

Two plaques which will decorate two posts that form the Stephen Crane Memorial Playground entrance. The plaque on the left bears a likeness of the author; the one on the right shows his birthplace.

Many of the plaques will be mounted on the posts that form the enclosure for the playground, which is located on the site of Stephen Crane's birthplace in Mulberry Place. Decorative iron railings were also made by WPA craftsmen for this project.

A ceramic portrait of Stephen Crane, one of the thirty-four plaques which are to be used in decorating the Stephen Crane Memorial Playground in Newark.

Forming a background for the playground is a wall made from brick salvaged when the Crane home was razed. On this wall will be a plaque, 21 inches in diameter, bearing a likeness of Mr. Crane. Beneath it will be a series of plaques, 22 feet long, bearing the following quotation from Crane's Black Riders:

"Ay, workman, make me a dream, a dream of my love.
Cunningly weave sunlight, breezes and flowers.
Let it be of the cloth of meadows. And—good
workman—and let there be a man walking thereon."

The remaining plaques, 11 by 17 inches, depict characters and scenes from some of Mr. Crane's best-known works, including the Red Badge of Courage, Black Riders, the Open Boat, War Is Kind, and Whilomville Stories.

The plaques were designed by Aart Karthof, a WPA artist. He was assisted by Max J. Herzberg, principal of the Weequahic High School, in selecting the material to be used on the plaques. Mr. Herzberg conferred with Carl Van Doren, authority on Stephen Crane, on the subject matter. The project was sponsored by the Newark Shade Tree Commission.

AIR HYGIENE FOUNDATION NAME CHANGED

The Board of Trustees of the Air Hygiene Foundation of America, Inc., has announced the change of the organization's name to Industrial Hygiene Foundation of America, Inc. The new name will more clearly describe the Foundation's expanding activities and membership services for the protection of employee health. At the same time that the name was changed, the Foundation, originally incorporated in Ohio in 1935, was reincorporated on July 23, 1941, under the laws of Pennsylvania.

When the Foundation was organized, emphasis was placed on silicosis, the No. 1 industrial health problem at that time. The Foundation's scientific approach to that problem is credited with having helped calm the hysteria then rampant. With the rapid advances of industrial hygiene and the multiplication of new occupational health problems, the work of the Foundation has steadily broadened.

A study is now under way, with the collaboration of the U. S. Public Health Service, to help reduce sick absenteeism which is costing the heavy industries alone about one billion man-hours yearly. Other accomplishments include (1) continuing studies of X-ray techniques for large-scale physical examinations in industry; (2) studies of the control of toxic fumes and gases, including proper precautions in welding; (3) a research, now in progress, to develop further practical data on exhaust ventilation for employee health protection; and (4) investigations in "protector" dusts, including aluminum, to combat dust diseases.

A storehouse of industrial health literature has been built up at the headquarters of the Foundation in Mellon Institute. Current literature is digested each month for the information of the members and to keep them posted on progress. This digest covers about three hundred journals in a dozen languages. Industrial hygiene laboratory facilities are also maintained at Mellon Institute. The Foundation now has industrial hygienists spending most of their time in the field making surveys for member companies. These surveys show the presence or absence of potential health hazards. Where hazards are found, remedies are recommended.

Sixth Annual Meeting

The Foundation will hold its sixth annual meeting at Mellon Institute, Pittsburgh, Pa., on November 12 and 13, 1941. The program, geared to produce practical data for today's needs, will revolve around the theme, "Defend the Defense Worker!"

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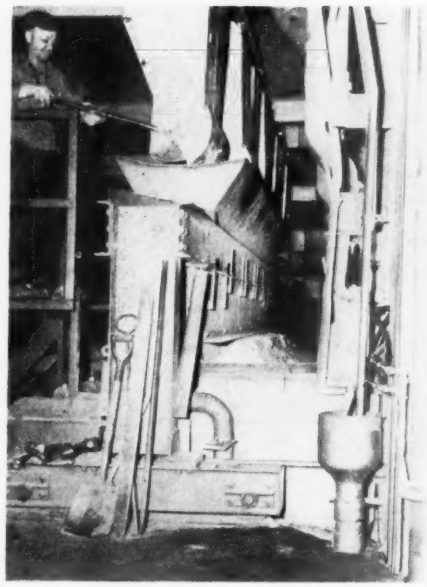

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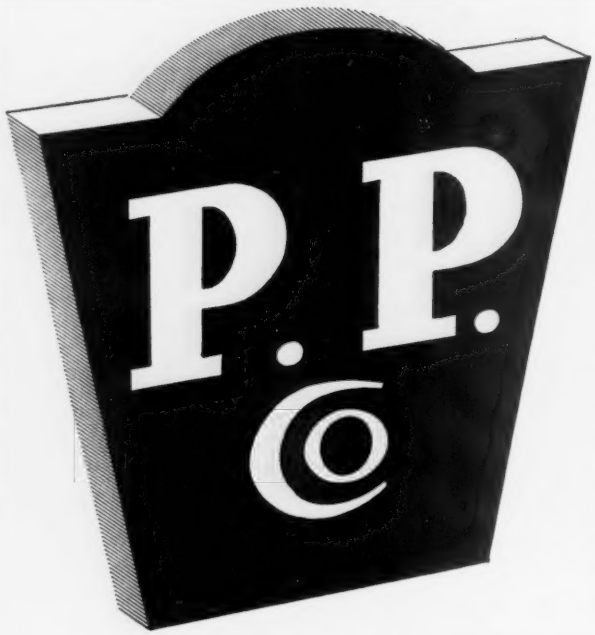

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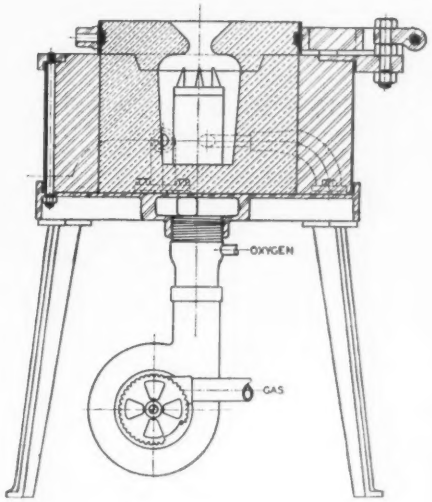

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Note how design accomplishes uniform distribution of fuel thru cast manifold . . . the four burners arranged tangentially, each with high temperature alloy burner tips . . . scientific curvature of the Sillimanite body, to reflect maximum heat upon the cone pat.

Note the all-Sillimanite body and lid . . . the rheostatic control of blower speed . . . the compact, rugged construction and generous insulation.

Developed by the Multiple Fellowship on Refractories at the Mellon Institute of Industrial Research, users find the DFC furnace the "last word" for determinations of Pyrometric Cone Equivalents.

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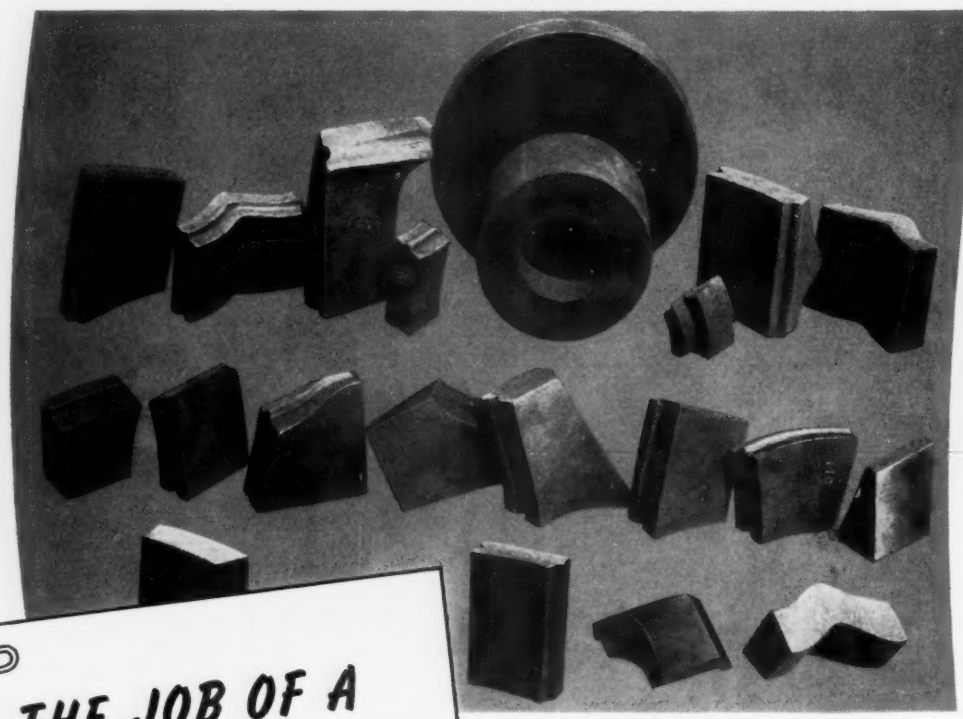


THE JOB OF A THOUSAND SHAPES

● There is an interesting story back of this job of a thousand shapes—a story that well illustrates the resourcefulness of Carborundum Refractory Engineering Service and the completeness of Carborundum Manufacturing Facilities.

The job was to provide a refractory lining to be used in a metallurgical process—a lining that would withstand molten metal, rapidly fluctuating pressures—at relatively high temperatures.

The specifications called for the building of a lining of highly complicated shapes of "Carbofrax", the Carborundum Brand Silicon Carbide Super Refractory. These shapes had to be designed to fit into a complicated shell, every unit keyed to fit and the whole to be mechanically stable.

It was a lot like a jig saw puzzle—except to our engineers. They studied the job, designed the parts, specified the right refractory material—a combination of application, design and manufacture—with the result that the lining for the shell, which holds eleven tons of metal, has set up an amazing record of performance.

A job that called for about a thousand different keyed fitted shapes!—many thousand pieces in all. Once again it was a case of a client asking "What can you do for us"—and we produced!

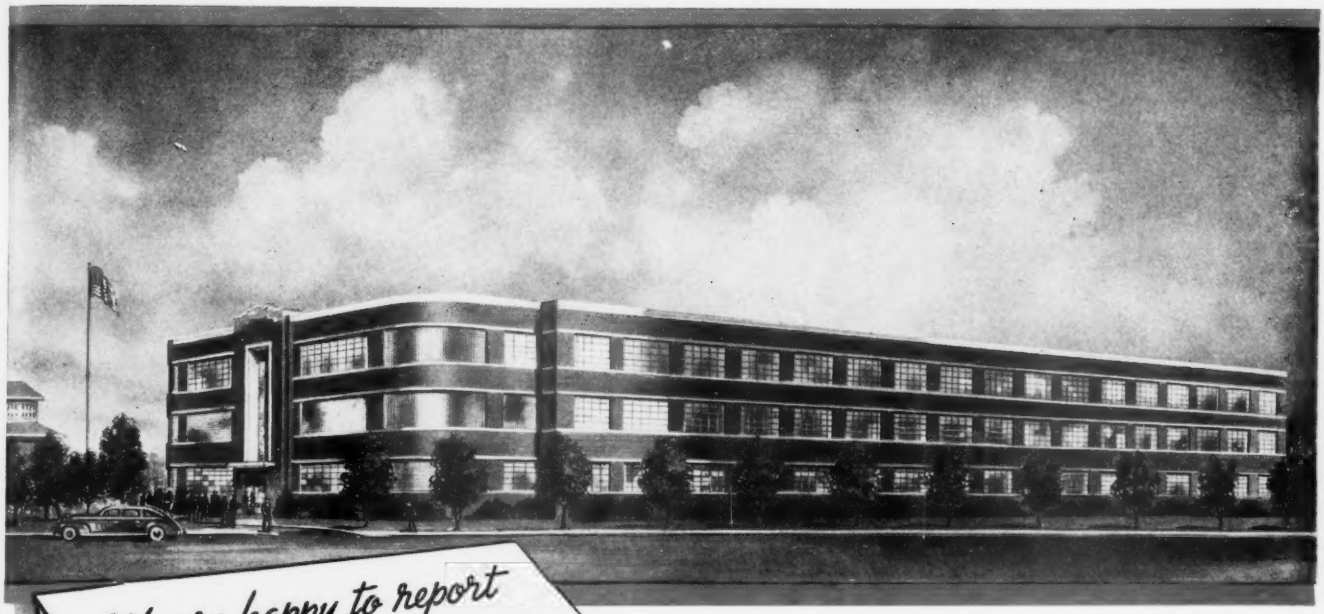
No matter what your use for super refractories may be, or what your refractory problems are, it will pay you to take advantage of Carborundum Engineering Experience and Manufacturing Facilities.

Refractory Division, The Carborundum Company, Perth Amboy, N. J.

District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Fire Brick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fireclay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.

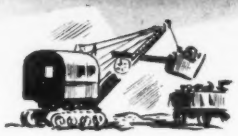
(Carborundum and Carbofrax are registered trade-marks of and indicate manufacture by The Carborundum Company)

REFRACTORY CARBORUNDUM PRODUCTS



We are happy to report

PROGRESS



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The cornerstone of this organization is a policy of continued improvement through research and development. The Engineering and Production Staffs of American Lava Corporation contain representatives of many of the leading technological institutions of this country. Thus it is only natural that four completely equipped new laboratories sweep across one floor of this new building. These four laboratories, electrical, chemical, mechanical and testing, are in charge of men whose skill is favorably known to leading engineers in this country and abroad. They are ready to work for you on any problem involving technical ceramics.

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Norton Co. (*Alundum-Crystolon*)

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Electro Refractories & Alloys Corp.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.

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Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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American Potash & Chemical Corp.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
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Pacific Coast Borax Co.
The Vitro Mfg. Co.

Borax Glass
American Potash & Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

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Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

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Harshaw Chemical Co.
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Boron Carbide
Norton Co.

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Electro Refractories & Alloys Corp.
Norton Co.
The Vitro Mfg. Co.

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Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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Carborundum Co.

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Drakenfeld, B. F., & Co.
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The Vitro Mfg. Co.

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Solvay Sales Corp.

Caustic Soda
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Denver Fire Clay Co.
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Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

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Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pennsylvania Salt Mfg. Co.
Sauereisen Cements Co.

Ceramic Chemicals
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Harshaw Chemical Co.
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Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
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American Lava Corp.

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The Vitro Mfg. Co.

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Great Lakes Foundry Sand Co.
Harshaw Chemical Co.
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Colors and Oxides; Smelter Oxides; Graining, Printing, Banding, Screening and Decalcomania Colors; Chemicals, and Mill Room Supplies.

CERAMIC COLOR & CHEMICAL MFG. CO... NEW BRIGHTON, PA.

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Fluorspar
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

French Flint
Eureka Flint & Spar Co.
Maxson, Elwyn L.
Paper Makers Importing Co.

Frit
Ceramic Color & Chemical Mfg. Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Fuel Oil Systems and Control, Stokers
Frazier-Simplex, Inc.

Furnaces
Carborundum Co. (*Carboradiant*)
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Swindell-Dressler Corp.

Furnaces, Enameling
Swindell-Dressler Corp.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Lancaster Iron Works, Inc.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.

Glass Sand
Great Lakes Foundry Sand Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Eureka Flint & Spar Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Eureka Flint & Spar Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Goggles
The Hommel, O., Co., Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.

Granulators
Lancaster Iron Works, Inc.
F. J. Stokes Machine Company

Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hydraulic Propellers
Denison Engineering Co.

Hydrofluoric Acid
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Iron Chromite
Harshaw Chemical Co.

Iron (Enameling)
American Rolling Mill Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Thomas Alabama Kaolin Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kilns, China (Decorating)
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Frazier-Simplex, Inc.
The Hommel, O., Co., Inc.
Swindell-Dressler Corp.

Kilns (Electric, Circular, Tunnel)
Swindell-Dressler Corp.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.

Kryolith (see Cryolite)
Pennsylvania Salt Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Electro Refractories & Alloys Corp.

Lehrs
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehr Loaders
Frazier-Simplex, Inc.

Linings (Furnace Refractory, Block Refractory Plate, Brick, and Tile)
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.
The Vitro Mfg. Co.

Lithium Carbonate
Drakenfeld, B. F., & Co.
Foote Mineral Co.

Lithium Minerals
Foote Mineral Co.

Loaders (Bucket)
National Engineering Co.

Magnesia (Fused)
Electro Refractories & Alloys Corp.
Norton Co.

Magnesia (Sintered, Calcined)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Porcelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
Foote Mineral Co.
The Hommel, O., Co., Inc.

Magnesium Carbonate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Manganese Dioxide
Drakenfeld, B. F., & Co.
Foote Mineral Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Masks (Breathing)
Drakenfeld, B. F., & Co.

Metals (Porcelain Enameling)
American Rolling Mill Co.

Micronized Products
Porcelain Enamel and Mfg. Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.
Spencer Lens Co.

Microscopes (Stereoscopic)
Spencer Lens Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Mixers
National Engineering Co.
F. J. Stokes Machine Company

Mixers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Mixers (Concrete, Paving, Road Paving, Plaster, Asphalt, Truck, Mortar, Bituminous)
Lancaster Iron Works, Inc.

Mixers (Laboratory)
Lancaster Iron Works, Inc.
National Engineering Co.
F. J. Stokes Machine Company

Mold Sanders
Lancaster Iron Works, Inc.

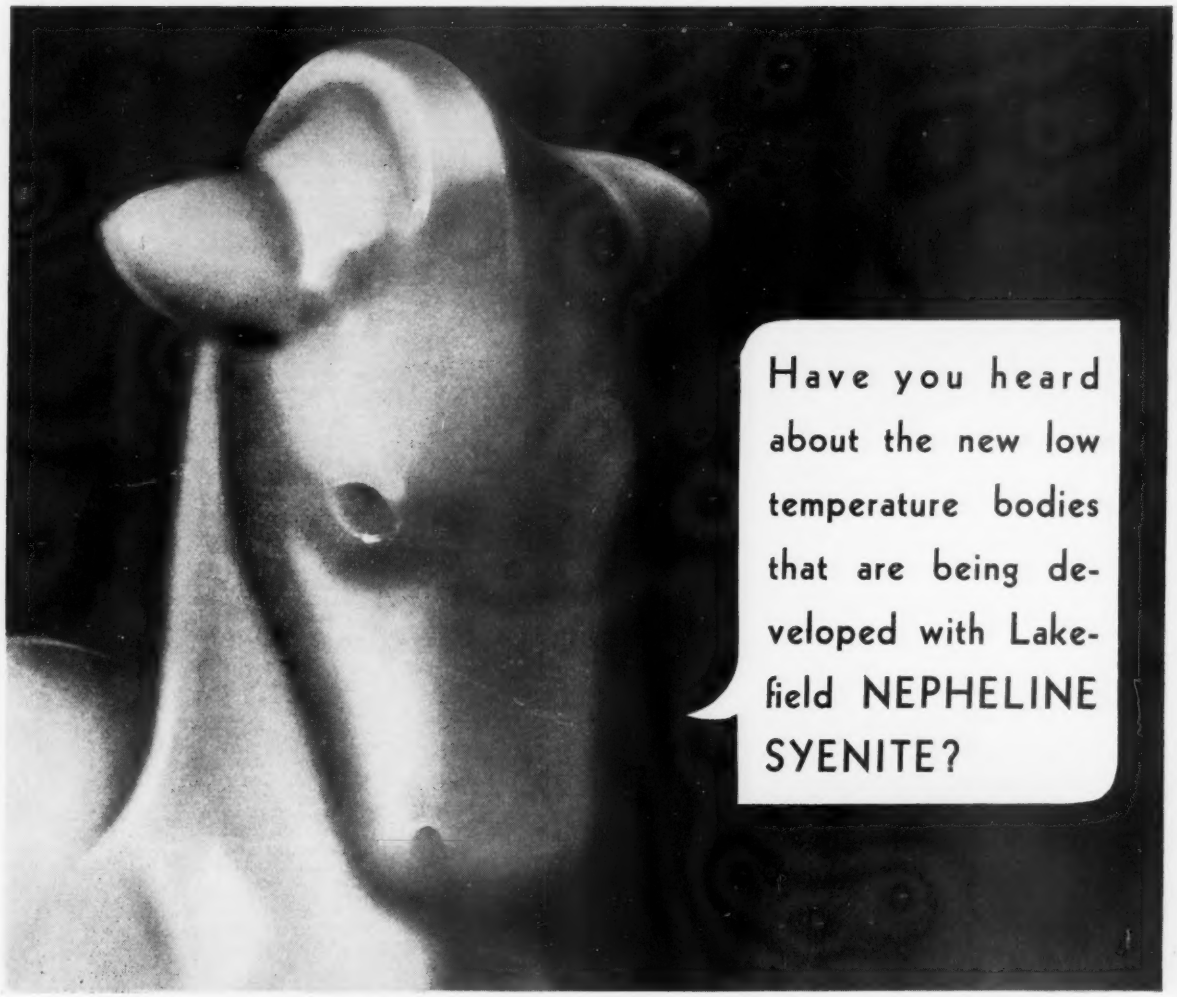
Muffles (Furnace) (Laboratory)
Carborundum Co. (*Carbofrax*)
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.

Mullers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

Needle Antimony
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Nepheline Syenite
Great Lakes Foundry Sand Co.



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Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Nitre
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

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The Vitro Mfg. Co.

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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
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Pins
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Industrial Ceramic Products, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg. Co.

Placing Sand
Great Lakes Foundry Sand Co.
Pennsylvania Pulverizing Co.
United Clay Mines Corp.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.

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Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

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Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
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Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
The Hommel, O., Co., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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Denver Fire Clay Co.

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Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

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F. J. Stokes Machine Company (Single Punch and Rotary)

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Lancaster Iron Works, Inc.

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Foote Mineral Co.
The Hommel, O., Co., Inc.

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Carborundum Co.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

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Leeds & Northrup Co.
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

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Lancaster Iron Works, Inc.

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Electro Refractories & Alloys Corp.
Spencer Lens Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.

Refractory Materials
American Lava Corp.
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
Norton Co.
Thomas Alabama Kaolin Co.
Titanium Alloy & Mfg. Co.

Respirators
Drakenfeld, B. F., & Co.
The Hommel, O., Co., Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
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Metal & Thermit Corp.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Potters Supply Co.

Salt Cake
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Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
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Pennsylvania Salt Mfg. Co.

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Great Lakes Foundry Sand Co.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel, O., Co., Inc.

Screening and Magnetic Separators
National Engineering Co.

Selenite of Sodium
Drakenfeld, B. F., & Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.

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Electro Refractories & Alloys Corp.
The Hommel, O., Co., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.

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Spencer Lens Co.

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Electro Refractories & Alloys Corp.
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Norton Co.

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American Potash & Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
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Harshaw Chemical Co.
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Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

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Ceramic Color & Chemical Mfg. Co.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
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Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
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The Vitro Mfg. Co.

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Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
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Sodium Uranate
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Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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Frazier-Simplex, Inc.

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Frazier-Simplex, Inc.

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Ceramic Color & Chemical Mfg. Co.
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Eureka Flint & Spar Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Pennsylvania Pulverizing Co.
The Vitro Mfg. Co.

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Spraying Equipment
The Hommel, O., Co., Inc.

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Potters Supply Co.

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Lancaster Iron Works, Inc.

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Industrial Ceramic Products, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Pennsylvania Salt Mfg. Co.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
International Pulp Company
Paper Makers Importing Co.

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Tank Blocks
Corhart Refractories Co.

Tanks (Pickle)
The Hommel, O., Co., Inc.

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Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Tile Setter Pins
Louthan Mfg. Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Thomas Alabama Kaolin Co.

Tile (Wall)
Denver Fire Clay Co.
Thomas Alabama Kaolin Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Trisodium Phosphate
Harshaw Chemical Co.

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Louthan Mfg. Co.
McDanel Refractory Porcelain Co.
Norton Co.

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Carborundum Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

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Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.

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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Water Softening Plants
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The Hommel, O., Co., Inc.
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Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
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Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
The Vitro Mfg. Co.

Zircon
Foote Mineral Co.
The Hommel, O., Co., Inc.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel, O., Co., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Zirconium Oxide
Foote Mineral Co.
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Titanium Alloy Mfg. Co.

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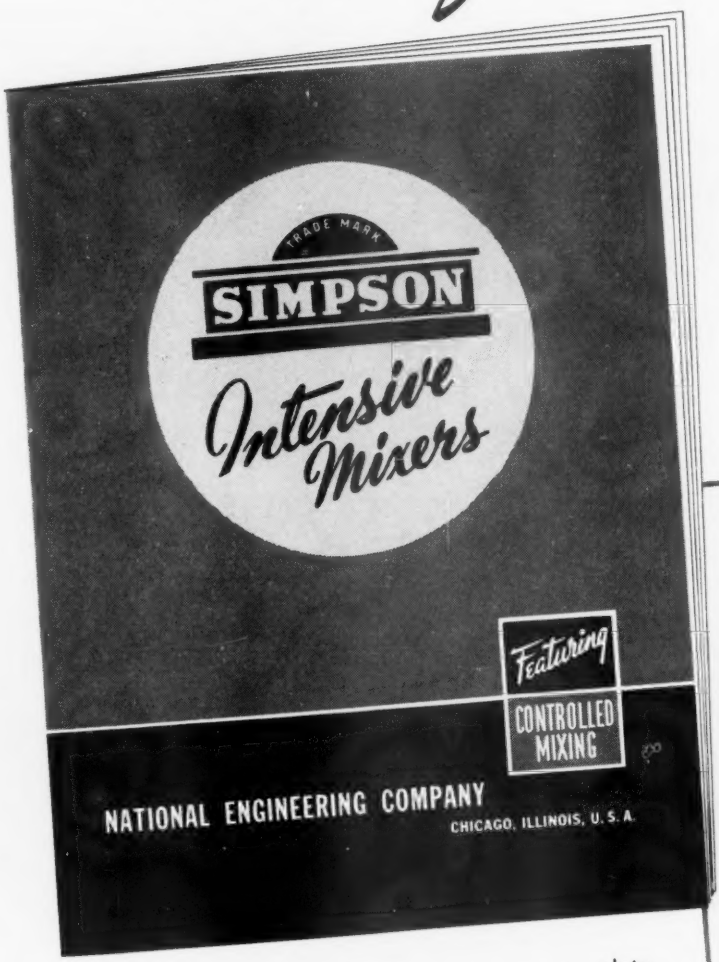

Here are some of the subjects covered in this new catalog:

- Mixing Storage Battery Plate Pastes.
- Blending of Graphite Products — Crucible stock.
- Controlled Mixing of Ceramic Bodies.
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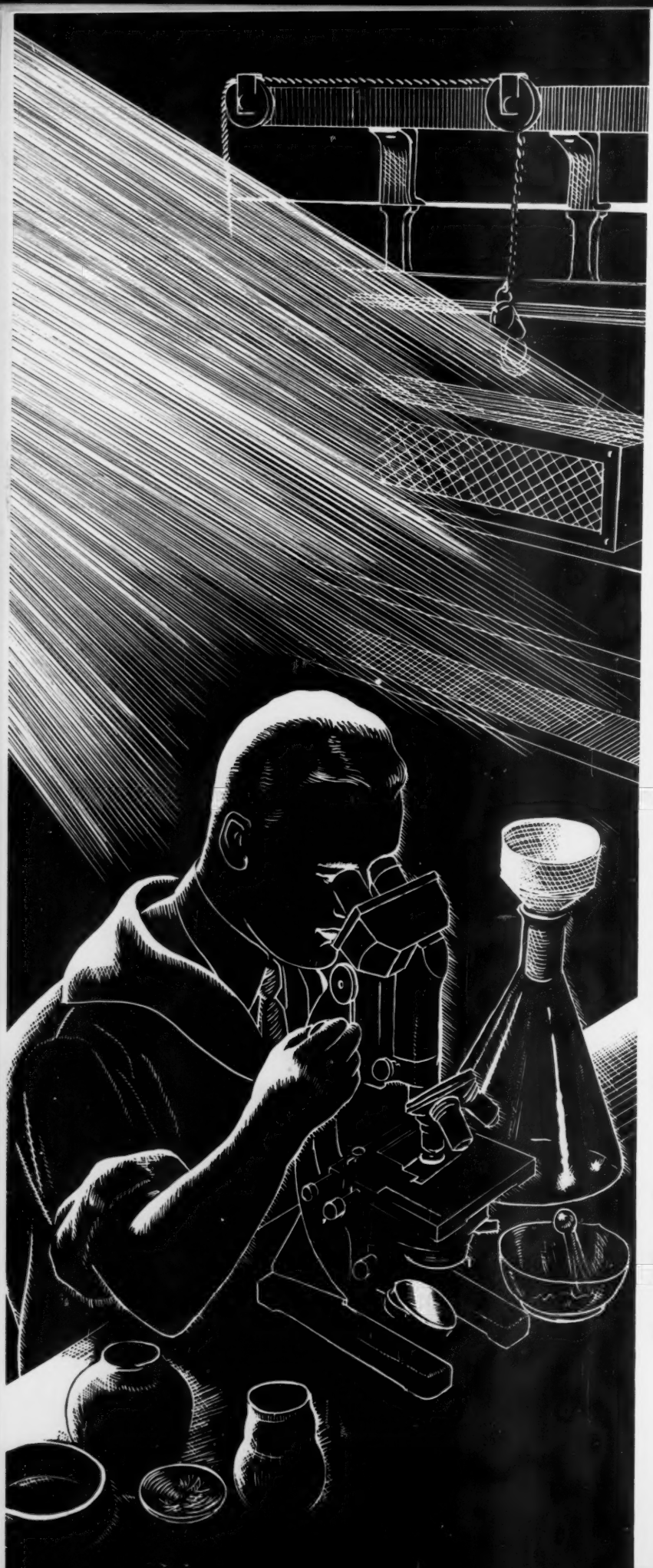

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Some Accomplishments of The Society

- By meetings and publications This Society has encouraged the establishment of courses of ceramic instruction and laboratories of ceramic research in several universities, thus making more generally available trained men and information.
- Ceramic research now constitutes a large and increasing part of the activities of such institutes as Mellon, Battelle, Lewis, and Armour.
- The U. S. Bureau of Mines and several of the state geological surveys and state ceramic associations were promoted by The American Ceramic Society.
- The technical activities of ceramic trade associations are closely allied with, and in several instances result from, particular activities of This Society.
- The informational value of privately owned trade journals has risen during the past forty years as a direct result of activities of This Society.
- The several technical organizations, such as those primarily interested in physics, chemistry, geology, metallurgy, mineralogy, and mining have symposia in which This Society collaborates to engage the broadest possible thinking and study on ceramic problems.

The Prime Purpose of The American Ceramic Society

is to promote ceramic arts, science, and technology. It is for this purpose that meetings are held, committees are working, and publications are issued. No privately owned organization could or would thus serve the technical interests of ceramic corporations. The three monthly publications of The Society are not in themselves the purpose of The Society's activities; they are merely working tools.

The returns from an investment in The American Ceramic Society of a minimum of $25.00 annually are not to be seen in the form of books alone but are realized in technical information obtained from the several educational and research institutions, trade associations, and trade publications, and particularly from better-informed employees.

A federation of persons and of firms with an organized program of educational activities does more than make known the results of research and plant experiences; it brings persons together and thus builds productive and profitable comradeships that are worth more than publications.

Members joining in December will be considered as for the 1942 calendar.

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Dear Pete:

Well, if the Yankees really do a good job of silencing the "Brooklyn Bums" at least some of the old die-hards down this way will be convinced that "Damnyankee" is not one word.

I hope you don't think we are the die-hard kind. We think that we have been and are doing a good job of supplying the industry with uniformly high quality BALL CLAYS. We do prefer, however, to spend our time on improvement rather than defending what we have done.

Yours for even better and more dependable BALL CLAYS.

Sincerely,

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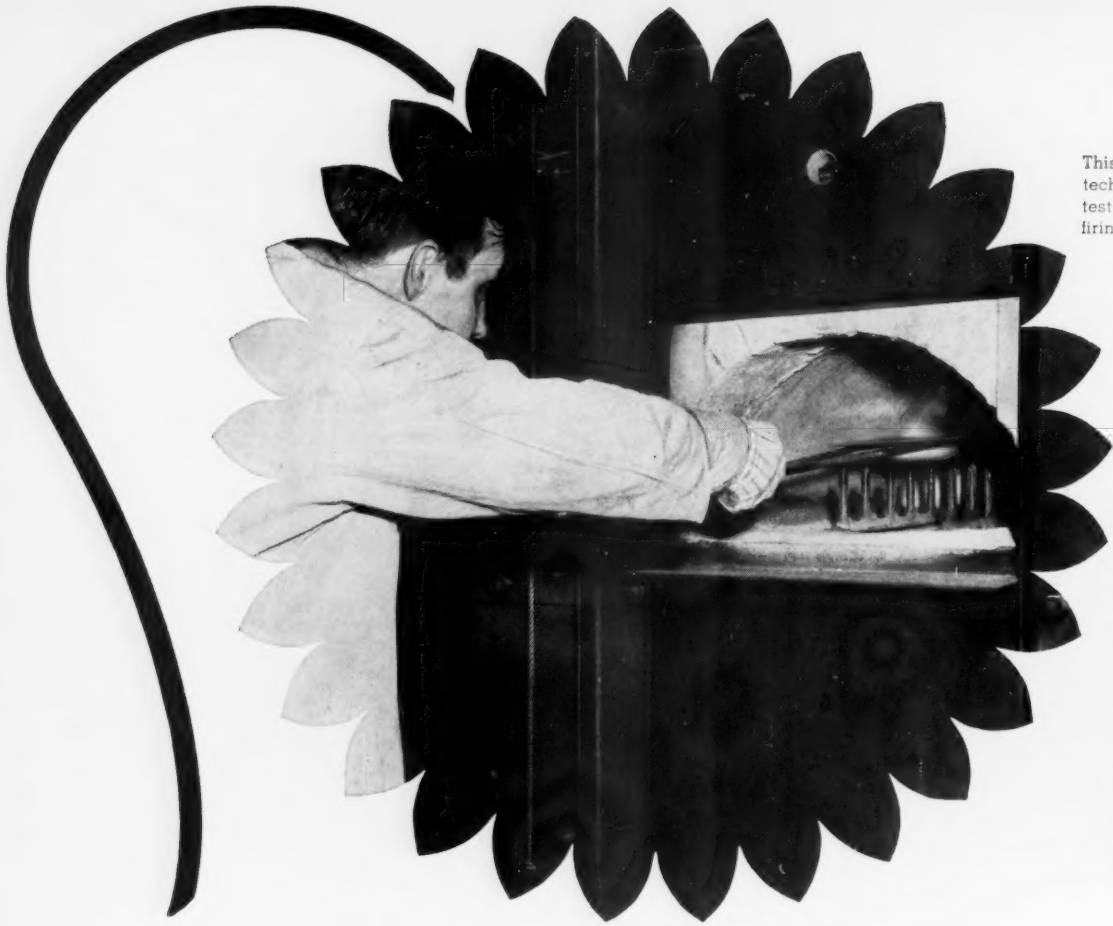
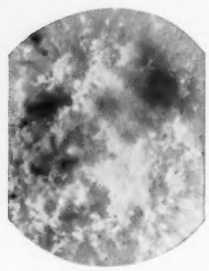


This Metal & Thermit technician is placing a test plate in furnace for firing.

Photomicrograph of sunflower, showing erupted material. Analysis in Metal & Thermit laboratory found cause to be tramp iron in batch.



the man with the sunflowers

Sunflowers may be all right in your garden, but they can prove to be an exasperating and costly source of trouble to ceramic manufacturers.

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Vol. 20, No. 10 (October), pp. 327-374 (1941)